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THE

SCIENCE AND ART

OF

SURGERY.

BEING

A TREATISE ON SURGICAL INJURIES, DISEASES, AND OPERATIONS,

BY

JOHN ERICHSEN,

PROFESSOR OF SURGERY AND OF CLINICAL SURGERY IN UNIVERSITY COLLEGE, AND SURGEON TO UNIVERSITY COLLEGE HOSPITAL.

AN IMPROVED AMERICAN EDITION,

FROM

THE SECOND ENLARGED AND CAREFULLY REVISED LONDON EDITION.

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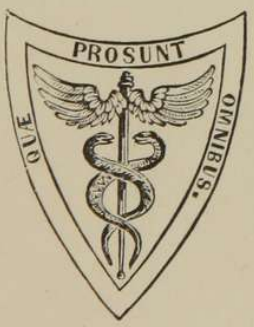

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AMERICAN PUBLISHERS' ADVERTISEMENT.

The high reputation which this work has so rapidly obtained in this country, has stimulated the publishers to render the present edition in every respect worthy the confidence of the American profession. During its passage through the press the sheets have been submitted to a competent surgeon, with the object of embodying in it whatever might be requisite to its improvement. There has been found, however, but little to add; the careful revision and extensive additions of the author having rendered unnecessary most of the notes which were introduced in the former American edition, and having brought the work thoroughly up to the present condition of European surgery. A few notes and a small number of wood-cuts only have therefore been introduced, elucidating some points of American practice. These additions are enclosed in brackets [ ].

Philadelphia, December, 1858.

PREFACE.

In preparing a Second Edition of this work for the press every page has been carefully revised. Some chapters have been almost completely re-written, the text has been considerably enlarged, and upwards of one hundred and sixty new illustrations have been introduced. The additions are almost exclusively of a practical character; my wish being to make the work a guide to the practitioner as well as a text-book to the student. Having this double object in view, I have entered with much minuteness into many practical details, which I think will be found to be as useful to the student as they are important to the practitioner. My increasing experience as a teacher leading me to fear that there is no little risk of the cultivation of the *Art* not keeping pace with the progress of the *Science* of Surgery.

The general arrangement of the work has been preserved. It is divided into three parts:—The First Division, under the head of "First Principles," contains some general observations on Operative Surgery, and more specially on Amputations, together with a condensed view of the Nature and Treatment of Inflammation. The Second Division comprises the consideration of Surgical Injuries, and the Third that of Surgical Diseases.

In considering both Injuries and Diseases it has appeared to me to be more consistent with a natural arrangement to treat 1st, of those common to all parts of the body, as Wounds, Abscesses, Ulcers, &c. 2d. The Diseases and Injuries of Special Tissues, as of the Osseous Tissue,—Fractures and Necrosis; of the Vascular Tissue,—Wounds of Blood Vessels and Aneurisms. And 3d. The Diseases and Injuries of Regions.

The more Special Operations I have considered as part of the Treatment of the different Injuries and Diseases for which they are required; a plan that, I thought, would be more practically useful than to describe them apart as a separate subject. I have limited

the Consideration of Affections of the Eyes to Injuries of those organs, their Diseases being a special subject, that would require for its proper description more space than could be allotted it in this Work.

In discussing the numerous topics that are embraced in a systematic Treatise on Surgery such as this, I have endeavored, so far as lies within its scope, and without entering into anything like an historical account, to ascribe to whomsoever it may be due the merit of improvements in Practice, or of discoveries in Pathology. In some cases, I may perhaps have accidentally omitted doing so, and in other instances, where the observation had become as it were the established and common property of the profession, I may purposely have avoided encumbering the text with names and references. In order to remedy this deficiency to some extent, I would beg to refer the reader to the more special Treatises on the subject-matter of the different chapters. Thus I would particularly direct his attention to the admirable Lectures on Pathology by Mr. Paget, to which I have been much indebted in preparing the chapters on Inflammation and on Tumors. To the works by Sir B. Brodie on Diseases of the Joints and Urinary Organs, to the Treatise of Stanley on the Bones, of Lawrence on Hernia, of Fergusson on Practical Surgery, of Cooper on Fractures and Dislocations, of Travers on Injuries of the Intestines, of Guthrie on Wounds of Arteries, of Sir R. Carswell on the Elementary Forms of Disease, and to those of Acton and Langston Parker on Syphilis. To the most excellent works of my former teachers, Samuel Cooper and Robert Liston, whose names I cannot mention without a ready and deep-felt expression of gratitude for much valuable instruction and personal kindness received from them in former years, I would especially refer the reader.

For any clerical errors in the work, I must beg the reader's indulgence. It has been prepared and written in the midst of the harassing and onerous duties that devolve upon a Hospital Surgeon, a Teacher of Surgery, and a Private Practitioner in the Metropolis, and which are but little favorable to literary pursuits.

In conclusion, I must express my acknowledgments to Mr. Hulme for much valuable assistance in carrying this volume through the Press.

JOHN ERICHSEN.

London, September, 1857.

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DIVISION FIRST.

FIRST PRINCIPLES.

CHAPTER I.

GENERAL CONSIDERATIONS ON OPERATIONS.

MANUAL dexterity is necessarily of the first advantage to a surgeon, and he should diligently endeavor to acquire the art of using his instruments with neatness, with rapidity, and with certainty; but manual dexterity must not be mistaken for professional skill, and desirable as it doubtless may be to be able to remove a limb, or to cut out a stone, in so many seconds; important, in a word, as it is to become a dexterous operator, it is still of far greater importance to become a successful one. The object of every operation is the removal of disease that either threatens the life, or that interferes with the comfort and utility of existence; and the more certainly a surgeon can accomplish this, the better will he do his duty to his patients, and the more successful will he be in his practice. Success then, in the result of an operation, whether that result be the preservation of life, or the removal of a source of discomfort, is the thing to aim at. To this, dexterity and rapidity in operating are in a high degree conducive; but there are various other considerations equally or still more necessary, the solution of which can only be afforded by an intimate general acquaintance with the science of surgery and of medicine. The diagnosis of the nature and extent of the connections of the local disease has to be made; lurking visceral affections must be detected, and, if possible, removed. The constitution of the patient must be prepared for the operation; the best time for its performance seized; and, after its completion, the general health must be attended to in such a way as shall best carry the patient through the difficulties he has to encounter, and any sequelæ or complications that arise must be met by, and must be subjected to, appropriate treatment. These, as well as the simple performance of the operation, are the duties of the operator; and on the manner in which these are performed, as much, or even perhaps more, than on the mere manual dexterity displayed in the operation itself, will the fate of the patient depend. It is well known that the result of operations differs much in the practice of different surgeons of acknowledged dexterity, and this variation in the proportionate number of recoveries cannot be accounted for by any difference in the degree of manual skill displayed in the operation itself; but must rather be sought in the greater attention that is paid by some surgeons to the constitutional treatment of their patients before and after the operation, and to their more perfect acquaintance with the general science and practice of surgery. Indeed, success in operative surgery depends greatly upon the selection of proper cases. The practice of operating in notoriously hopeless cases with the

view of giving the patient what is called a last chance, is much to be deprecated, and should never be done. It is by operating under such circumstances, especially in cancerous diseases, that much discredit has resulted to surgery, for in a great number of instances the patient's death is hastened by the procedure; which, instead of giving him a last chance, only causes him to be dispatched sooner than would otherwise have happened.

The condition of a patient that principally determines the result of an operation is the state of his general health. Indeed, the state of the patient's constitution influences the success of an operation far more than the mechanical dexterity with which the surgeon performs it. It is no uncommon circumstance to see patients sink after the most dexterously performed operations for hernia, stone, the ligature of arteries, &c., owing to some morbid condition of the blood or the system that disposes to diffuse inflammation; whilst, on the other hand, some patients will make the most remarkable and rapid recoveries after they have been mutilated with but little skill. Persons of an irritable and anxious mind do not bear operations as well as those of a more tranquil mental constitution. Those also of a feeble and irritable habit of body, especially nervous and hysterical women, with little power of circulation, cannot bear up against severe surgical procedures, being apt to become depressed, exhausted, and to sink without rallying. That combination of debility and of irritability, the consequence of want, of dissipation, and especially of the habitual excess of alcoholic stimulants, which is so commonly met with in the inhabitants of large towns, renders them peculiarly unfavorable subjects for operations, which are consequently less successful amongst them than in the more healthy and temperate inhabitants of country districts. The condition of the patient's heart should also be carefully looked to before an operation is undertaken. Fatty degeneration of this organ, as indicated by its feeble action, by irregularity and want of power in the circulation, by breathlessness, and by a distinctly-marked arcus senilis, should make the surgeon careful in undertaking any operation attended with much loss of blood, or shock to the nervous system; though it need not be a bar to its performance, if the disease for which it is to be practised would otherwise be fatal. Disease of the lungs, of a phthisical character, when active or advanced, is incompatible with the success of an operation, but under certain circumstances, as will be explained when speaking of diseases of the joints, and fistula in ano, an operation is justifiable and proper, even though the patient be consumptive. Perhaps the most serious constitutional affection, and the one that more than any other militates against the success of an operation, is a diseased state of the kidneys, with albuminuria or diabetes, the inflammatory action that is set up is apt to run into a low diffuse and sloughing form, and this is especially the case in all operations about the genito-urinary organs. The contamination of the patient's system by malignant disease must always prevent our operating, as a return of the affection will most certainly speedily take place. And, lastly, no operation, save of the most urgent necessity, and to rescue the patient from immediate death, as for the suppression of arterial hemorrhage, should ever be performed whilst he is laboring under erysipelas, phlebitis, or any diffuse inflammation; and even during the epidemic prevalence of these affections, operations that are not of immediate necessity, as for the removal of simple tumors, especially about the head, should be postponed until a more favorable season. Operations in very old people, if of a severe character, and attended by much shock to the system, are commonly fatal; thus, amputations in individuals above the age of seventy, are very rarely successful.

The *causes of death* after operation are partly dependent upon the operation itself, but in the great majority of cases, they are more connected with the hygienic influences by which he is surrounded, than with the local injury inflicted during the operation. How often do we not see patients carried off by

fatal diseases supervening on the most trifling operations, as the removal of a finger or toe, or of small encysted tumors of the scalp, from some condition of the system that is unconnected with the injury that has been inflicted; a condition that only required the local disturbance of the operation to call it into activity.

The conditions that are most to be dreaded by the surgeon, and that most commonly tend to a fatal result after operation are, shock, hemorrhage, and surgical fever, with its local complications.

The *shock of an operation* may prove fatal in various ways; from the severity of the mutilation, as in a case of double amputation; from the nervous centres being implicated, as in the removal of large tumors from the face, that have connections with the base of the skull; from fear, or from the state of nervous depression in which the patient has previously fallen, causing him to feel the influence of an operation disproportionately to its severity; these various effects of shock have, however, been much lessened since chloroform has been generally administered in operative surgery. Chloroform, however, does not remove the physical impression produced on the system by a severe mutilation, hence the influence of a serious and prolonged operation is still manifested in the production of shock, although the patient may have experienced no suffering.

Hemorrhage, if very copious, may destroy the patient by inducing syncope that may be immediately fatal; or, by increasing the influence of the shock, so that he cannot rally; or it may be attended by serious after-consequences, such as the supervention of hemorrhagic or irritative fever. When occurring a few hours, or a day or two after an operation, it usually proceeds from the imperfect ligature of the vessels, or from arteries bleeding after the setting-in of re-action, which had not furnished blood whilst the patient was under the influence of the shock of operation. On recovery from chloroform also, it not unfrequently happens that arteries begin to spout, that yielded little or no blood whilst the patient was in a state of anæsthesia. Under these circumstances, it is of far less moment, and less frequently fatal, than when occurring at a later period, arising from some morbid condition of the wound or system, and usually associated with a typhoid condition, in consequence of which the proper formation of plastic matter is interfered with. During the performance of the operation hemorrhage should, as much as possible, be prevented; the operation itself is a cause of depression, and any great loss of blood would only greatly aggravate this.

Surgical fever, of an irritative type, associated with cerebral symptoms, may set in with unusual violence; but it never proves fatal without the manifestation of some local inflammatory mischief. These local inflammations are indeed the most frequent causes of death after operations; they are all of a diffused, congestive, or adynamic character, and are frequently connected with a prevailing epidemic constitution at the time. They are of two distinct kinds; the first, taking their origin from a wound as from a central starting-point, are the various forms of erysipelas, diffuse inflammation of the cellular tissue, inflammation of veins, and absorbents, hospital gangrene, and diffuse suppuration of bone. The others are those secondary affections which fall upon some internal organ, as for example, the lungs, liver, brain, or gastro-intestinal mucous membrane. The most frequent and fatal of these various complications, is congestive inflammation of the lungs; which is an almost invariable accompaniment, if not a cause of death in surgical fevers. The membranes of the brain in other instances are found inflamed; and more rarely the gastro-intestinal mucous surface is affected. These various causes of death are necessarily most active amongst the poorer inhabitants of large towns, whose vitiated constitutions render them far less able to bear up against the depressing influences of a severe surgical operation, than those whose days are passed in the purer air and healthier occupations of a country life. Internal organs may also have

been so injured by the accident or disease, that necessitates the operation, as to be unable to recover themselves, and falling into a state of inflammation or gangrene, may destroy life. This we see happen in the intestines in cases of hernia, and in the brain in injuries of that organ.

The surgeon being convinced of the necessity of having recourse to operation, should proceed fully and unreservedly to lay before his patient the state of the case, and if necessary state the reasons that render an operation imperative, in order to obtain his consent, and that of his family. In the event of the patient refusing to submit, what course should the surgeon pursue? In this he must be guided partly by the nature of the proposed operation; and partly by the state of the patient, and his capability of forming a correct judgment of his case. If the operation be one of expediency, merely for the relief of an infirmity or the removal of an ailment, that does not directly jeopardize life, most certainly no surgeon would think of undertaking it without the full consent of his patient. If on the other hand it be an operation that is imperatively necessary for the preservation of life, in which the delay of a few minutes or hours may be fatal to the patient, as in the case of the proposed ligature of a wounded artery, or the relief of a strangulated hernia, and in which the patient not being aware of, or capable of being made to understand the necessity for immediate action, is unwilling to assent to the proposal, the surgeon truly will be placed in a dilemma of anxious responsibility; between allowing the patient to fall a sacrifice to his ignorance or timidity, and attempting, perhaps unsuccessfully, to rescue him from inevitable death against his own consent. I believe the proper course for the surgeon to pursue under such circumstances, is to judge for the patient in a matter on which he is clearly unable to form an opinion, and to compel him, so far as practicable, to take the necessary steps for the preservation of his life, or to put him under chloroform, and when narcotized, to perform any operation that may be necessary. In the event of the patient being insensible, as after an injury of the head, the surgeon must necessarily take upon himself to act as the case requires. Children cannot be considered capable of giving an opinion as to the propriety of an operation, the consent of the parents is here necessary, and quite sufficient, and in their absence, the case being an urgent one, the surgeon must stand in loco parentis, and take all responsibility upon himself.

These points then having been determined, the patient should be prepared for the operation, if the case be sufficiently chronic to admit of the necessary delay. This preparation must not consist in any routine system of purging and starving, which is ill-calculated to support the constitution against the call which will be made upon its powers: but by adapting our means according to the condition of the patient to support the powers of life. The tendency to erysipelas, pyemia, and low and diffuse inflammation generally, is materially lessened by supporting the patient's strength, by means of a nutritious diet, previous to the performance of the operation. Indeed, in many of the more severe cases of compound fracture and disease of the joints, it is only by the use of a nutritious diet, and by the administration of stimulants, often in large quantities, that the patient can be brought into a condition to bear the shock and consequent depression of the operation. It may even be found necessary to administer from half-a-pint to a pint of brandy, with perhaps a considerable quantity of wine, together with eggs, beef-tea, and other nourishment, for some days before the operation can be undertaken. This is more particularly the case with hospital patients of bad constitution, who have met with serious accidents, attended by much suppuration and irritative fever. In the more chronic cases, the time should be seized for the operation when the secretions are free, the tongue clean, and the action of the skin and kidneys in a healthy state; and above all the mind should be kept tranquil and hopeful, being allowed to dwell as little as possible upon the impending event.

The immediate preparations for the operation should always be superintended by the surgeon himself. He must see that the table is solid, and of a convenient height, well covered with blankets, and provided with pillows; and that the light of the room is good. There must be a sufficient supply of sponges and of basins, with hot and cold water; and if the operation be likely to be attended by much hemorrhage, a tray filled with sand or saw-dust should be provided, in order to catch the blood. The surgeon must then look over his instruments, comparing them, if the operation be complicated, with a list previously made out; he must see that they are arranged in the order that they are wanted, and properly covered with a towel. Much of the successful performance of an operation depends on the attention and steadiness of the assistants. Of these there should be enough, but not too many. In all capital operations three or four will be required. One for the administration of the chloroform, another to command the artery, a third immediately to assist the surgeon, and the fourth to hand sponges, instruments, &c. The duties of the assistants should be performed in silence, and each man must carefully attend to his own business, and not neglect this, as is too often done, in his anxiety to crane over and see what the surgeon is about. There should be no unnecessary talking when once the patient is on the table, the surgeon's directions being conveyed by a brief word or two, a look, or a sign with the hand.

The surgeon himself must always feel the heavy responsibility that hangs over him during the performance of a great operation—"at that moment when," as Dr. Grant has elegantly said, "death everywhere surrounds his knife, and he is endeavoring to convey all his knowledge to its point." But having carefully considered each successive step of the operation, provided for every emergency that can by any possibility arise in the course of it, and trusting in Him, from whom all knowledge is derived, to strengthen his judgment and guide his hand aright, he will proceed to the performance of his duty with self-reliance, and in the full confidence that he will be able to accomplish all that art can do.

The introduction of anæsthetics into surgery is undoubtedly one of the greatest boons ever conferred upon mankind. To the patient it is invaluable in preventing the occurrence of pain, and to the surgeon by relieving him from the distress of inflicting it. Anæsthesia is not, however, an unmixed good. Every agent by which it can be induced produces a powerful impression on the system, and may occasion dangerous consequences when too freely or carelessly given, and even with every possible care it appears certain that the inhalation of chloroform is in some cases almost inevitably fatal. We cannot purchase immunity from suffering without incurring a certain degree of danger. There can, however, be little doubt that many of the deaths that have followed the inhalation of chloroform have resulted from want of knowledge, or of due care, on the part of the administrator. Yet, whatever be the precautions taken, there is reason to fear that a fatal result must occasionally happen. This immediate risk, which is but very trifling, is more than counterbalanced by the immunity from other causes of death during operations which used formerly to occur.

There is, however, another question in relation to chloroform which deserves the most serious consideration on the part of the surgeon; viz: Does it influence the rate of mortality after operations? On this point there is conflicting testimony. Dr. Simpson has published statistics to show, that the mortality after operations has lessened since the introduction of chloroform. Dr. J. Arnott, on the other hand, adduces figures to prove that it has materially increased, in amputation by 12, in lithotomy by as much as 28 per cent. I am inclined to believe that the rate of mortality has increased since the use of chloroform in operative surgery. But is this increase altogether due to any effect produced on the system by the inhalation of chloroform? May it not, in some measure at least, be owing to operations being often performed in very doubtful or extreme cases, now that they can be done painlessly, when formerly the suffering

inflicted would have deterred the surgeon from proposing, or the patient from acceding to their performance? A surgical operation was formerly, from the pain attending it, looked upon as a more serious affair than it is at the present day, and surgeons were not willing to inflict suffering unless there were a good prospect of a successful issue. Now, however, that the most serious operations can be performed without any consciousness to suffering, the surgeon, in his anxiety to give his patient a chance of life, may not unfrequently operate for disease or injury that would otherwise necessarily and speedily be fatal, and which formerly would have been left without an attempt at relief.

Making, however, all allowance for the extension of operative surgery to extreme cases that were formerly not thought to come within its range, I cannot but think that chloroform does exercise a noxious influence on the constitution, and does lessen the prospect of recovery in certain states of the system, more especially when the nervous power is enfeebled or the blood is in an unhealthy state; under such circumstances the depressing influence of chloroform appears to me to act injuriously, the patient does not rally well after the operation for which it is administered, and immunity from suffering is purchased by a lessened chance of recovery.

Anæsthesia by the administration of chloroform is best commenced before the patient leaves his bed. It should never be given but by a person accustomed to its use, and in whose capability the surgeon has full reliance, as nothing embarrasses him more, during the operation, than to have any doubt about the chloroform being properly administered. The following is the way in which chloroform may, I think, most conveniently and safely be administered. On a piece of folded lint, about two inches square, and consisting of three doubles, about ʒj of chloroform is poured, and the lint is then held at a distance of about three inches from the nose of the patient, so as to permit of the very free admixture of air with the first few inhalations of the vapor. After the lapse of about half a minute, the lint is brought nearer to the patient's nose, to within a distance of perhaps an inch, being never allowed to touch; at the same time a porous towel, not doubled, is lightly laid over the face of the patient and the hand of the operator, so as to prevent the escape of the chloroform vapor, but not to interfere with the admission of air. During the whole time it is the duty of the administrator to keep his hand on the pulse, to watch the breathing, and occasionally to examine the pupils of the patient.

The principal points to be attended to during the inhalation of this potent agent are, that it should not be given too suddenly, or in too concentrated a form, and that whilst under its influence the patient be not raised up off the couch or table. If the lint is too much saturated with it, and be held too closely applied to the mouth and nostrils, the patient will not be able to get sufficient atmospheric air, and may speedily become partially asphyxiated, choking violently, struggling to get free, and becoming purple in the face, with a full, slow pulse. Care should be taken not to compress the abdomen in holding the patient, for as the respiration becomes chiefly or wholly diaphragmatic, it may be seriously interrupted by any pressure on the abdominal wall. Whilst under its influence the patient should never be raised up, as has just been stated; for as this agent exercises a powerful sedative action on the heart, sudden, and perhaps fatal, syncope may ensue, by putting the patient in the erect position. Hence also it is dangerous to administer it in those operations that require to be performed whilst the patient is in the erect position. It is well to caution the patient not to take anything to eat for two or three hours before its administration, lest it induce vomiting of the partially digested meal. With due caution it may be given with perfect safety to individuals of all ages. I have operated on infants less than a month old, as well as on octogenarians, under its influence. In administering it to young children, Dr. Snow recommends that it should be diluted with rectified spirit. The first influence

of chloroform appears to be exercised upon the nervous system. The patient becomes excited and talkative, and a state of unconsciousness is induced, the muscular system at the same time being rendered rigid and tense. At this time the heart's action is usually quickened, and more forcible than natural. As the administration of the chloroform continues, however, complete paralysis of sense and motion is induced. The patient becomes altogether unconscious to all external impressions, the muscles become relaxed, and the action of the heart slow and feeble. This diminution in the power of the heart's action is well marked in the lessened force of the jet of blood from cut arteries. The respirations become shallow and feeble in proportion as the sensibility of the nervous system and the energy of the muscular movements are lessened, and the blood in the arteries becomes dark; in fact, a semi-asphyxial state sets in. When thus fully anæsthetized, the patient is on the very verge of death, and requires the most careful watching on the part of the person who administers the chloroform; his fingers should never be off the pulse, or his eyes taken away from the countenance of the patient. The breathing should be very carefully watched: when it becomes embarrassed the chloroform must be given sparingly, and when it becomes stertorous it should be discontinued entirely. In this state the inhalation of a small additional quantity of this potent agent, the application of the vapor in too concentrated a state, or the sudden raising up of the patient, might occasion a fatal result from paralysis of the heart.

If the inhalation of chloroform has been suspended, great care should be taken when its administration is recommenced, lest the already enfeebled heart be suddenly overpowered by the sudden exhibition of too large a volume of vapor in a concentrated form.

It should be borne in mind that it is not necessary in all operations to administer chloroform to the same extent. In all the greater operations, as amputations, lithotomy, and the ligature of arteries, enough should be given to completely paralyze muscular movement, as well as to suspend sensibility and consciousness. In operations for hernia, also, and all other proceedings implicating the abdominal walls, if complete muscular relaxation be not induced, great inconvenience and not a little danger may result. So, also, in very painful operations about the anus and genital organs, a full dose of chloroform should be given. But for the removal of many tumors about the trunk, or in many of the minor operations on the extremities, and about the head and face, muscular relaxation is not so necessary, and it will be sufficient to give enough chloroform merely to suspend sensibility and consciousness to pain.

In certain diseased conditions of the system the administration of chloroform requires much care, but, as a general rule, it may be stated that whenever the constitutional disease has not advanced to such a degree as to contra-indicate an operation, chloroform may be given. In the early stages of phthisis it may usually be safely inhaled, but in some cases of bronchial irritation the vapor is apt to produce troublesome cough. When the heart is diseased great caution is necessary, more particularly when its muscular substance has undergone fatty degeneration; the sedative influence of the chloroform being apt to produce a sudden depression or arrest of the heart's action under these circumstances. In many, perhaps the majority, of the cases of death from chloroform, the fatal event has been traced to this cause. In valvular disease of the heart I believe that it may be more safely given. In persons who are epileptic, and in those who suffer from congestion of the brain, it requires to be cautiously administered, as in the earlier stages of anæsthesia much cerebral excitement is apt to be evinced. In hysterical subjects chloroform is said to induce a tendency to laryngeal spasm. The most dangerous condition in which to administer chloroform is that in which, in consequence of renal disease, the blood is loaded with urea: in such cases epileptiform convulsions are readily induced, with lividity of the face, and a tendency to stertor and coma.

Should chloroform be given in operations rendered necessary by severe injuries, during the period of the continuance of the shock of the accident, as in primary amputations? Under such circumstances, its use has been objected to on the ground that it would act injuriously by still further lowering the already depressed vital powers of the patient; and that the pain of the operation, if performed without it, would prove a good stimulant, and thus serve to rouse the patient. But would this really be so? Is the pain of an operation a stimulant? In order to answer this question, let us observe the condition of a patient immediately after the performance of a severe amputation — as an amputation — without his having been anæsthetized, and we shall find, that so far from having been restored or stimulated, he will have been seriously depressed by it. The pulse will be small, feeble, and slow; the surface cold; and the mind, perhaps, scarcely conscious; in fact, though a slight degree of pain, as a pinch or a prick, may act as a stimulant, very severe suffering is a most powerful depressing agent, capable of itself of destroying life. The pain of an operation performed soon after the occurrence of a severe injury, so far from rousing the patient, appears to me to act most injuriously, by inflicting a second shock upon the system before, perhaps, it has fairly recovered from the depressing effects of the first; and it is by preventing this, that chloroform is of such inestimable advantage in these cases.

Death from chloroform may occur in three different ways; viz., from coma, asphyxia, and syncope; through the brain, the lungs, or the heart. When by coma, the patient will be heard suddenly to breathe stertorously; he becomes livid in the face, and is convulsed; the heart continues to beat until the last moment of life, and death appears to result primarily from the circulation of dark blood through the nervous centres. This form of death chiefly occurs in individuals who are epileptics, or whose blood is loaded with urea. When death occurs by asphyxia, it is the fault of the administrator, sufficient air not being admixed with the chloroform vapor to maintain the respiratory function. The symptoms are those of asphyxia, consisting of lividity of the surface, distension of the jugulars, struggling for breath, and speedy cessation of the heart's action. In some cases, death is not immediate, but a low form of congestive pneumonia sets in, the blood never becomes properly aërated, and death ensues in a few days without perfect recovery having taken place. In death from cardiac syncope, the patient, after a few inspirations, suddenly becomes pale and faint; the pulse beats in a flickering manner a few times and then ceases, though respiration may continue; the fatal event being evidently due to paralysis of the heart. This is an accident, that may occur to individuals who are depressed either by mental emotion, or by physical debility before taking the chloroform, and that is not unfrequently connected with a fatty heart. It is best guarded against by giving the patient a little stimulant, as brandy or ammonia, before commencing the inhalation.

The treatment of an overdose of chloroform is conducted on two principles: 1stly, the establishment of respiration, either natural or artificial, so as to empty the lungs of the vapor contained in the air-cells, and to aid the oxygenation of the blood; and 2dly, the stimulation of the heart's action, and the maintenance of the circulation.

The first principle of treatment — that of re-establishing respiration — is most serviceable in the asphyxial form; the other, that of stimulating the heart, when the syncopal symptoms are present. But in all cases they may most advantageously be employed in combination.

The treatment to be adopted on the occurrence of dangerous symptoms, or of apparent death from chloroform, is as follows:

1. The administration of the vapor must at once be discontinued.

2. The tongue should be seized with the fingers, with a hook or forceps, and drawn out of the mouth; and the larynx pushed up so that the glottis may be opened.

3. Fresh air should be admitted around the patient by opening doors and windows, and by preventing bystanders or spectators from crowding round.

4. All constriction should be removed from the patient's throat and chest, and these parts freely exposed.

5. Artificial respiration must *at once* and without delay be set up, whilst these other measures are being carried out, either by the surgeon applying his mouth to the patient's lips and thus breathing into the chest; or, what is preferable, by the alternate and steady compression and relaxation of the walls of the patient's chest.

6. Electricity should be applied freely over the heart and diaphragm through to the spine, by means of the Electro-Magnetic, or other convenient apparatus.

7. Friction may be employed to the extremities; a little brandy rubbed inside the mouth; and cold water dashed on the face, as accessory means.

The administration of ether is effected by the application over the nostrils of a hollow sponge, saturated with the best washed ether. This mode is preferable to the use of any of the complicated inhalers, inasmuch as by the admixture in the sponge of a sufficient quantity of atmospheric air with the ethereal vapor, all danger of asphyxia is avoided. To prevent the pungent effects of ether on the cutaneous surface, Dr. Warren has proposed the anointing of the face with some protective unguent. The first effects of the inhalation are resistance on the part of the patient, and some slight irritation of the air passages, the pulse is increased in rapidity, rising to one hundred pulsations per minute, the face becomes flushed, and the movements and speech of the patient excited. This stage of excitement soon passes, and full etherization is then effected; the pulse falls to sixty or seventy, the countenance becomes pale, insensibility to pain is produced, and the whole muscular system is relaxed. The indications of this state are the dropping of the upper eyelid, and the inability of the patient to sustain his arm when raised. This is the period most favorable for the performance of operations, and especially for the reduction of dislocations, and of fractures attended with shortening of the limb. The time required for the induction of the anæsthetic state varies, averaging, perhaps, about five minutes, a longer period than is required in the administration of chloroform, and attended with slightly more excitement. The fatal consequences which have attended the employment of chloroform, has caused the American surgeons almost entirely to trust to ether in preference. Certainly ether is a safer agent than chloroform, no death having as yet resulted from its administration; and the only argument in favor of the use of chloroform over ether is, chloroform is the most *convenient* agent, its effects being produced more quickly, and no disagreeable smell being left behind, as is the case with ether. In fact, we use chloroform in preference to ether, on the same principle that induces us to incur the increased risk of an express, rather than submit to the slower but safer progression of a parliamentary train.

Local Anæsthesia, by means of the application of a frigorific mixture of ice and snow, as introduced by Dr. J. Arnott, may very conveniently be employed in many cases in which the internal administration of anæsthetics is either inadmissible or inconvenient. It can only be produced with certainty, however, in those cases, in which the incisions merely implicate the skin and subcutaneous structures, as in opening abscesses, slitting up sinuses, avulsion of toe-nails, or removing small and superficial tumors. For all such purposes, however, it is extremely valuable.

The mode of using the frigorific mixture is as follows: — About a tumblerful of rough ice is put into a strong canvass bag and finely pounded with a mallet. It is then poured out on a sheet of paper, and half its bulk of salt is quickly mixed with it by means of an ivory or wooden paper knife. The mixture is then put into a muslin or gauze bag, suspended from a wooden ring, and applied to the part for from five to ten minutes. So soon as the skin becomes white,

opaque, and hard, anæsthesia is produced, and the incisions may be made without any pain being experienced. The frozen part speedily recovers itself, no inconvenience resulting.

The *incisions* for the operation itself should be carefully and properly planned, so as to give sufficient space, with as little mutilation as possible, and in some cases they must be arranged with the view of subsequent extension, should the state of things discovered at the operation require it. They should be made freely without tailing. The point of the knife being entered and withdrawn perpendicularly, and made to cut with a rapid sawing motion, due attention being at the same time paid to the resistance of the tissues, so that the surgeon does not, by using too much force, plunge or jerk his scalpel or bistoury into the part. The scalpel should be set on a smooth ebony handle, which is less slippery than an ivory one, when wetted with blood, and admits of greater delicacy of touch; it should be light in the blade, nearly straight-backed and slightly bellied on the cutting edge. When very free and extensive incisions are required, as in the removal of large tumors, &c., Liston's spring-backed bistoury, of proper size and shape, is a most convenient instrument. Whilst the incisions are being made, care must be taken that too much blood is not lost. This may be prevented most conveniently by the use of the tourniquet, or by an assistant compressing the main artery in the groin or axilla. If the seat of the operation be such as not to admit of this, the assistant must compress the bleeding vessels, as they are divided during the operation; and as soon as it is concluded, he must remove his fingers from them one by one, to admit of their being ligatured. If oozing continue, after all jetting vessels have been tied, this may be arrested by exposure to the air, or by pouring a stream of cold water upon the wound. In some cases the pressure of pad and bandage, and in others that of a sand-bag will arrest this bleeding, but in the majority of instances position and coaptation of the flaps will suffice.

The *sutures* should be introduced at the time of the operation, whilst the patient is still under chloroform, but should be left to hang loose, and not be drawn tight until the wound is dressed. In this way the patient is saved the pain, which is always much complained of, of introducing the sutures at the time of the dressing. They should be made of dentists' twist, of moderate thickness, so as not to cut out readily, and need only be very fine in case of plastic operations, when scarring is objectionable. In some cases, where much tension is exercised or great accuracy required, hare-lip pins are preferable to ordinary sutures.

When the wound is small, and all oozing has ceased, its lips may at once be brought together. This may also be done even when large, if the patient be of a very irritable constitution and sensitive to pain, the whole dressing being performed whilst he is still under the influence of chloroform. But in general, when the wound is extensive, as in cases of amputation, I prefer, and almost invariably adopt, the plan recommended by Mr. Liston, of leaving the wound open with a piece of wet lint interposed between its lips, for two or three hours, until its surface has become glazed; the lint is then carefully removed, any small coagula gently taken away, and the sides of the incision brought into apposition, the sutures being drawn tight and tied. Long strips of plaster of moderate width should now be applied; these may either be of the isinglass or the common adhesive kind, both having advantages that recommend them in particular cases, with corresponding disadvantages that exclude them in others. The isinglass plaster is clean, unirritating, and, being transparent, allows a good view of subjacent parts, but it has the disadvantage of loosening and stripping off when moistened by the discharges or dressings, which often renders it a very inefficient support. The common adhesive plaster is more irritating and dirty, but it is much stronger and holds tighter, not loosening as readily when moistened. In large wounds, as in those of amputation, I prefer

the isinglass for the first dressing, and leave it on until loosened by the discharges, and then use the common adhesive plaster for subsequent applications, when less irritation is likely to be induced. In some cases in which the wound is in such a situation as to admit of it, and more particularly if it be a deep though clean cut — as after the extirpation of tumors, — great advantage will be found after the sutures have been introduced and the plasters applied, in padding the part externally with a firm compress of lint, and then applying a roller tightly but evenly over all. In this way will not only all oozing be prevented, but direct coalescence and union of the opposed surfaces may be secured.

The position of the part should be carefully attended to, so that the edges and surfaces of the incision be brought into proper contact; more may be done in this way, without pain or uneasiness to the patient, than by any amount of traction and pressure that can be exercised. The part should be so arranged that one end of the incision may be the most dependent, so as to facilitate the escape of discharges. One end of the ligatures should be cut off short, the other left of a moderate length to hang out of the lowest part of the wound, provided that by so doing it do not cross its whole line. A narrow strip of water-dressing should then be applied along the edge of the incision. The first dressings need not be changed until about the third day after the operation, unless they become loose or are too tightly applied, when they may be snipped across. About this time, or earlier in many cases, a serous bloody fluid will be discharged from between the strips of plaster and the sutures. The escape of this must be facilitated by removing any obstacles that are in its way. If, however, the sutures do not interfere with the escape of the discharges, and are not producing undue irritation or excessive traction, they may be left in for a few days longer. In amputations, especially in cachectic subjects, they may frequently be left undisturbed for six or eight days, with much advantage.

If union do not take place by adhesive inflammation, and suppuration has commenced, with much tension and heat about the part, the substitution of a poultice for the water-dressing will be advantageous. When suppuration has fairly set in, these applications should be changed at least twice or thrice in the twenty-four hours. The neglect of this precaution often gives rise to much irritation, and retards the healing process by the accumulation of discharges in and around the wound. Care should also be taken that there is a free escape for the pus, which may sometimes be pent up by the two early cohesion of the edges, without a corresponding agglutination of the deeper surfaces of the wound. As granulations spring up, it may become necessary to substitute astringent dressings for the emollient ones, and the parts must be well supported by bandages, especially in amputations, and in all cases where there is a tendency to bagging of matter.

The *constitutional after-treatment* of operations demands as much attention on the part of the surgeon, as the management of the wound itself. Immediately after the operation, and before the effects of the chloroform have passed off, the patient should be comfortably arranged in bed, with the clothes supported by a cradle, or other contrivance, away from the part implicated; an opiate should then be administered, or a little wine and water, if there is faintness, and the patient kept as quiet as possible.

With regard to the diet after the operation, this must depend entirely on the patient's constitutional powers, his age, and upon the severity of the operation to which he has been subjected. If the patient's strength be good, not having been broken by previous disease or suffering, and if the operation be a slight one, as the amputation of a finger, or the removal of a small tumor, he may have half his usual diet allowed for a few days, but without any stimulants. If the operation have been more severe, but not capital, no solids should be allowed, but broths and nourishing liquids alone given. If the operation be a capital one, the patient's health and strength being otherwise good, he may be

restricted to farinaceous slops and beef tea until suppuration has come on; indeed, up to this time, the febrile reaction will usually prevent the patient taking solids. Some light pudding may then be added, and the diet may, as the case progresses, be gradually improved by the successive addition of fish and the lighter kinds of meat, with a moderate quantity of stimulants, as required, until it reach the normal standard. It not unfrequently happens, however, that a totally different course must be pursued. If the patient have been much reduced by long-continued suppuration, or other depressing causes before the operation; is old and weakly in constitution, or has been in the habit of taking a very considerable quantity of stimulants, it will be absolutely necessary to depart from the routine plan, and to adopt a tonic and stimulating mode of treatment. Indeed, in hospital practice especially, I find this by far the most useful mode of treating patients after severe operations; without it, many would have sunk, whom I have seen saved by the free administration of large quantities of brandy, wine, porter, eggs, and beef tea, from the very time of the operation; that stimulant being given to which the patient is accustomed in a state of health. I believe also that this plan of treatment is the best preventive to those low and diffuse forms of inflammation that are so commonly fatal in these cases, and when they come on I know of no better remedy than the brandy and egg mixture of the Pharmacopœia, freely administered. In all this, however, the surgeon must be guided by the patient's pulse, his previous habits, and the power of his constitution; and nothing requires greater judgment than the administration of stimulants, according to these particulars. The great importance of attending scrupulously to the general cleanliness of the patient, and to the ventilation of the ward or room in which he is lying, as the best means of preventing the occurrence of the lower forms of inflammatory mischief, need scarcely be insisted on, as these hygienic precautions are universally recognised as being of the first importance under such circumstances.

The various special operations will be considered when treating of the several injuries and diseases for which they are required; but as amputations do not readily fall under any special head, being required for a vast variety of different conditions, it will be more convenient to consider them here.

CHAPTER II.

AMPUTATIONS AND DISARTICULATIONS.

The term "amputation" properly means the separation of a limb from the body, but it is sometimes applied to the removal of other parts, as the breast or penis. The frequency of amputations of the limbs has much lessened of late years; other and less severe modes of treatment being now successfully had recourse to in many cases of diseased joints, of aneurism, and of compound fractures, that were formerly submitted to the knife. But yet, amputations are amongst the most frequent operations in surgery, and will continue to be so as long as the human body is liable to severe mutilations, to gangrene of the limbs, and to malignant and other incurable diseases of the bones and joints. It has been somewhat the fashion to decry amputation; and to speak of this operation as an opprobrium to curative surgery. But though no surgeon can deprecate unnecessary amputations more strongly than I do, yet I cannot admit that the removal of a limb differs from other operations, which are only attempted when all

other means have failed in curing the diseased part, or saving the patient's life. And surely, it is rather a subject of just pride than the reverse, for the surgeon to be able with ease, and by a single operation, to save the whole of the body, though he sacrifice a limb that has been utterly and incurably disorganized or spoilt by disease or injury. In the performance of an amputation, also, much dexterity may frequently be displayed, and there is commonly great scope for surgical skill in the constitutional treatment of the patient, both before and after the operation.

An amputation may be done in the continuity of a bone; or at a joint, when it is called a *disarticulation*. In either case, hemorrhage during the operation is the great danger which must be carefully guarded against. As a general rule, it is better to prevent this by the application of a tourniquet, than by trusting to the compression of the artery by an assistant; the tourniquet arresting the flow of blood through the collateral vessels as well as the main trunk, whilst an assistant can only stop the current of blood that passes through the latter. When the tourniquet is applied, the pad should be carefully placed over the artery, and the band buckled pretty tight, but the instrument should not be screwed up until the moment of the operation, lest venous congestion take place on the limb, and an inordinate quantity of blood be lost. So soon as the main arteries have been tied, after the removal of a limb, the tourniquet may be unscrewed, and the band taken off, the assistant, however, keeping his finger on the artery, lest a ligature slip; for if it be only left half loosened, it will often happen that venous hemorrhage continues abundantly from the stump, in consequence of the pressure of the instrument being still sufficient to prevent the return of the blood through the veins. This will at once cease on taking the tourniquet completely off, and elevating the cut surfaces.

In amputations and disarticulations, the surgeon has the choice of three operative procedures: — by the circular method — by flaps — or, by a combination of the two, the formation of skin-flaps with a circular cut through the muscles. It is not my intention to enter into a discussion as to the relative merit of these procedures, for which I would refer to the writings of Liston and Velpeau. I believe that by either the circular or the flap method an equally good stump may ultimately be formed; but that much will depend upon the special dexterity that the surgeon may have acquired, by the habitual performance of one or other of these operations. Educated in the doctrines of Mr. Liston, who invariably amputated by the flap method, and who certainly did this with wonderful rapidity and precision, I have been in the habit of performing this operation in preference to the circular, over which it certainly possesses the special advantages of greater celerity in performance, more perfect coaptation and smoothness of the opposite sides of the wound, and a greater tendency to union of the stump by the first intention.

The surgeon should always stand so that he may support and grasp the limb to be removed, his left hand being placed on the outer side, in amputations of the left limbs — on the inner side, in those of the right.

The amputating instruments must be in proper order, and of good construction. For the smaller amputations, straight spring-backed bistouries, in ivory handles, will be required, narrow or broad in the blade, according to the size of the part to be removed. Scalpels also, not too broad in the blade, are useful in those cases in which the bistoury, from its length, might be inconvenient. Cutting-pliers, with long and strong handles and short blades, either straight or curved, as may be most convenient, are especially required in amputations about the hands and feet. The knives for the larger amputations should have smooth ebony handles, and be well balanced. The back of the blade should run straight to the point, and be well rounded. The edge should taper off towards the point, with a good convexity. The breadth of the blade should vary from the $\frac{6}{10}$th to the $\frac{8}{9}$th of an inch, and its length must be proportioned to the thick-

ness of the limb to be removed. As a general rule, in order to make a good sweeping cut, so as to form a well-rounded and smooth flap, the blade should be in length equal to about double the thickness of the limb. The saw should be strong in the blade and back, so as not to bend in cutting. The blade must be of good breadth, and, in order not to hang as it works its way through the bone, must be somewhat broader at the cutting edge than elsewhere. The teeth should not be too fine, and must be set crossways. The artery forceps may either be of the ordinary "bull-dog" make, or they may be broad towards the point, so as to allow the knot more readily to be slipped over the point to be deligated.

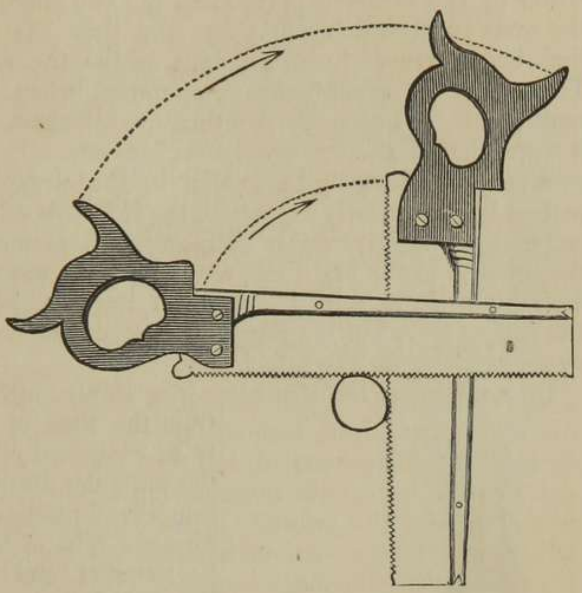
The flaps may be made either by cutting from without inwards, or by transfixion — cutting from within outwards. Transfixion should be preferred in fleshy parts, as the thigh or arm; but cutting from without inwards will be found to afford the best result, and is indeed the only mode of forming the flap in some situations where the bones are thinly covered, as on the outer side of the fore-arm, the anterior part of the leg, or just above the ankle-joint. When the patient is extremely muscular, and the amputation has to be done in the arm, thigh, or leg, it will be found to be most convenient to have skin-flaps, made by cutting from without inwards, dissecting up the integuments from the fascia to a sufficient extent, and then making a circular cut through the muscles down to the bone, thus only leaving a skin covering. The advantage of this procedure over the ordinary flap or circular operation is very great under certain circumstances. In both cases, but more especially in flap operations on stout muscular subjects, a large pad of muscle is apt to be left in the stump. This, which at first sight might appear an advantage, as an additional covering to the bones, is a decided disadvantage, inasmuch as it usually projects by the retraction of the skin covering it, sloughs, and interferes with the proper union of the flaps. If the limb have been the seat of much suppurative action, the muscles become softened and do not retract, and are apt afterwards to project between the skin-flaps, giving rise to much trouble and delay in the healing of the stump. This pad is also disadvantageous after cicatrization is completed, as it then forms a soft flabby and bulbous end to the stump instead of a firm hard cicatrix.

So soon as the incisions have been made through the soft parts, the bones must be cleared for the application of the saw. This is best done, when there is only a single bone, by a firm circular sweep of the knife from heel to point round the under segment of the bone, and then another round the upper surface, in the opposite direction. If there be two bones, care must be taken in clearing them not to direct the edge of the knife upwards into the interosseous space higher than the line to which the saw is to be applied, lest any artery be cut high up in this situation, where it is always difficult to secure it, owing to its retraction above the membrane.

The bone having been properly cleared, the flaps must be forcibly retracted by an assistant, in order to admit of the proper application of the saw, which should always be made opposite the highest point to which the incision is carried through the soft parts. For the purpose of retraction the assistant's hands are quite sufficient, though some surgeons are still in the habit of using retractors, made of split pieces of linen cloth or of wash-leather. In order to saw the bone quickly and steadily, there are several points deserving attention. The first cut should be made so as to form a deep groove to receive the teeth, by pressing the left thumb on the bone, and applying the heel of the saw, held horizontally, along this, by which it is steadied; the instrument must then be drawn fairly and sharply along the whole line of its teeth from heel to point. The groove thus formed receives the edge of the saw, and the bone may then be quickly cut through by long, light and sweeping movements of the instrument from point to heel, the position being gradually changed from the hori-

zontal to the vertical as progress is made. The surgeon must, with his left hand, support the part to be removed; and care must be taken not to bear upon this, so as to snap the bone as it is weakened by the action of the saw; nor should it be so much raised as to run the risk of locking the saw. When there are two bones in the limb of equal strength, as in the fore-arm, they should be cut through at the same time; but in the leg, the fibula, being the weakest, should always be first divided. Should the division be made irregularly, and splinters of bone project, these must be snipped off with cutting pliers.

Fig. 1.



After the limb has been removed, the ligature should be applied. The main and larger arteries must first be tied. For this purpose, fine compressed whipcord is the best material. The ends of these ligatures knotted together must be left long, so that they may be distinguished. Usually from two to four or six smaller vessels require to be tied, and they should be secured with ordinary ligature thread; but sometimes, either from the existence of malignant disease in the limb, or when extensive suppurative action has been going on in the limb, the stump is excessively vascular, and a very large number of ligatures may be required. I have more than once had occasion to apply between twenty and thirty ligatures to vessels in the arm and thigh under these circumstances. As union always takes place by granulation in such cases as these, it signifies little how many are put on, the smaller ones separating early. Sutures must then be introduced through the edges of the wound, but may be left loose; and wet lint applied between the surfaces and over the outside, the dressing of the wound being deferred for a few hours until the surfaces are glazed. At least this is the plan, introduced by Mr. Liston, that I think should be generally followed, more particularly in cases of primary amputation, and in all wounds where union by adhesion may be hoped for. But in amputations for disease, when patients are in a low and irritable condition, I think it is better to apply the dressings immediately after the performance of the amputation, before the effects of the chloroform are recovered from. Before doing this, it is desirable that all oozing should have ceased, and with this view, after the ligatures have been applied, I commonly pour a jug or two of cold water over the face of the stump, and then proceed with the dressings, which must be conducted in accordance with the general principles to be laid down when we come to speak of wounds. The stump should not be bandaged until the third or fourth day, unless it is very fleshy and heavy; and at first the roller should not be brought over its face, but merely by circular turns, as far as the line of incision. When suppuration is subsiding, and cicatrization going on, the bandage may advantageously be brought over the face of the stump. As a general rule, it will be found that a narrow roller will adapt itself better than a broad one. After cicatrization is completed, the patient should be allowed to go about on crutches, but must not wear an artificial limb for several months, until the parts have

become firmly consolidated; during the whole of this time the stump should be kept carefully bandaged, and not exposed to injury.

Simultaneous or synchronous amputation of two limbs, requiring removal for severe injury or for gangrene, has occasionally been successfully practised, either by two surgeons performing the two amputations at the same time, or by the same surgeon doing first one and then the other; the vessels of the first limb being secured by an assistant, whilst the second limb is being removed. The object in synchronous amputation when the removal of two limbs is required, is, to lessen the continuance of shock to the system, by throwing, as it were, that of the two operations into one. In doing this, however, the surgeon must necessarily be guided by the circumstances of the cases. If the patient be very greatly depressed, the infliction of so severe an injury as a double amputation might probably extinguish life at once; and if possible to wait after the removal of the first limb, and before the second was amputated, it might be desirable to do so, until the shock of the first operation had passed off; but if the patient were not too much depressed, the double simultaneous amputation would probably be the safe course.

On examining *the structure of a stump*, after a year or two have elapsed from the time of its formation, it will be found to be composed of a mass of fibro-cellular tissue, the muscular and tendinous structures that enter into the formation having become thus transformed. The ends of the bones will be found to be rounded, and the medullary canal filled up, the vessels being obliterated up to the nearest collateral branch (Fig. 2). The ends of the nerves are thickened, and commonly assume a bulbous appearance (Fig. 3). On examining these rounded or oval tumors, they will be found to be fibro-cellular masses having nervous fibrillæ thinly scattered throughout.

Fig. 2.

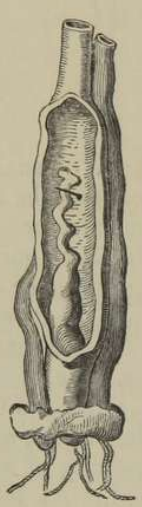


Fig. 3.

The proper adaptation of artificial limbs is a matter of considerable consequence, and the ingenious mechanical contrivances that are at the present day adapted to stumps, leave little to be desired. The surgeon had better leave the details of these mechanical contrivances to the instrument-maker; but he should see that they are made light, consistently with sufficient strength and support, and that the end of the stump is never pressed upon by them.[1] Thus, after amputation of the thigh, the artificial limb should take its bearing point from the lower part of the pelvis and hip. In amputation immediately below the knee, this joint should be bent and received into the socket of the instrument, and if the amputation be at a lower point than this, and the stump be extended into the artificial limb, its end must be protected from injurious pressure. Even in the case of disarticulation at the ankle-joint, where the soft tissues of the heel are left, pressure can seldom be borne upon the end of the stump.

Morbid conditions of stumps.—It not unfrequently happens that the end of the bone in a stump necroses. This occurs either in consequence of the injury inflicted by the jarring of the saw, or happens in those stumps that unite by the second intention, and where the bone consequently lies bathed in pus for a considerable time, being exposed between the flaps, and thus at last losing its

[1] [The most perfect of all the artificial limbs we now possess, is the one invented by Mr. Palmer, Chestnut Street, Philadelphia. This piece of mechanism received the prize-medal at the London Exhibition of 1851. It merits the entire confidence of the surgeon.]

vitality. This is especially apt to happen in persons of feeble constitution in whom the limb has, previously to the operation, been the seat of abscess that denudes or otherwise injures the vitality of the bone. In these cases a fistulous opening will be left leading down to the necrosed bone, which usually separates three or four months after the operation in the shape of a complete ring, with irregularly-spiked prolongations stretching from its upper part (Fig. 4); after this has been removed, the stump becomes firmly consolidated.

Fig. 4.

Conical or sugar-loaf stumps, as they are called, commonly form in consequence of the flaps having originally been cut too short, but in other cases they may occur, though the stump may have been skilfully fashioned, in consequence of the soft parts which have been the seat of inflammatory action and suppuration before the amputation, retracting during the granulating process, so as to denude the bone. In such cases as these, great retraction and contraction of the flaps are apt to go on during cicatrization, so that the bone may never be covered at all, but be exposed at the bottom of an irritable ulcer; or if the soft parts do coalesce, the cicatrix will be unable to support the slightest pressure without becoming ulcerated. Under these circumstances, the only remedy consists in laying open the stump, and cutting off about three inches of the bone.

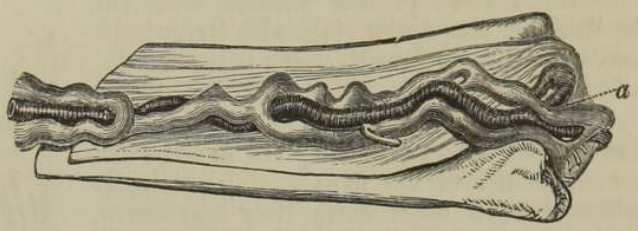
If the stump be too long and projecting, so as constantly to be in the patient's way, there is no remedy but to perform a second amputation higher up. This is especially required in badly fashioned stumps of the leg where the limb has been removed too far below the knee, so that it projects backwards in an awkward manner, and is constantly liable to accident when the patient uses a wooden pin.

Painful and spasmodic stumps. — The nerves in a stump naturally become somewhat expanded and bulbous; and no material inconvenience results from this condition. But it occasionally happens that a distinct tuberose enlargement forms in connection with one of them, attaining the size of a cherry or a walnut, and this being pressed against the end of the bone, or implicated in the cicatrix, becomes the seat of intense pain of a neuralgic character, more particularly whenever it is touched. Under these circumstances excision of this bulbous extremity of the nerve is necessary, and will effect a cure. But besides this form of painful stump, which may happen in the strongest and healthiest subjects, and is entirely dependent on local causes, there is another condition in which the stump becomes not only the seat of intense pain, but usually of convulsive twitchings. This form of painful stump arises from constitutional causes, and invariably occurs in females, more particularly in those of the hysterical temperament, and who are subject to neuralgic pains elsewhere. In these cases the general cutaneous sensibility of the stump is increased; it is often the seat of convulsive jerkings or twitchings, and the pain is of a more or less intermittent character, being increased under the influence of various emotional and constitutional causes. In cases such as these, the treatment should be conducted on the general principles that will be fully discussed when we come to speak of neuralgia. No excision of the nerves of the stump, or even amputation higher up is of any avail: the disease being constitutional, will certainly return in each successive stump, until at last the shoulder or hip may be reached without any permanent benefit accruing to the patient.

Aneurismal enlargement of the arteries of a stump is of extremely rare occur-

rence. The only case with which I am acquainted, is one recorded by Mr. Cadge, in which an aneurismal varix formed in a stump after disarticulation at the ankle-joint (Fig. 5 *a*).

Fig. 5.



Strumous or malignant degeneration may occur in a stump, presenting the ordinary characters of these affections met with elsewhere. In the strumous stump secondary amputation may advantageously be performed, but on the recurrence of malignant disease, it is seldom justifiable, as there is probably deposit in internal organs or contamination of the lymphatics.

The *fatty degeneration* of the muscles of a limb, arising from their disuse, gives rise to a peculiar appearance in the stump. During the amputation, the muscles look like pieces of yellow wax, and are firm: no atrophy, so far as size is concerned, having taken place; the fat being deposited between the muscular fibres, producing atrophy of them by its pressure, and occupying their place; the general size of the limb and fulness of the stump being consequently preserved. Union takes place under these circumstances, though somewhat slowly; at least in several cases in which I have observed this condition it was so. In one of these I amputated the leg for disease of the foot of nine years' standing, and in another the thigh for disease of the knee of fourteen years' standing.

Mortality after amputation. — The general causes of death after operations have already been considered, but we must now consider some special points connected with the relative mortality after amputations of different kinds; and the cause of the difference that exists. The principal causes of death after amputation are the influence of shock, the occurrence of secondary hemorrhage, of erysipelas, phlebitis, pyemia, and congestive pneumonia; besides these, hospital gangrene and sloughing of the stump, occasionally carry off the patient.

The circumstances which most influence the general result of amputations, as well as the particular cause of death after the operation, may be divided into two classes. 1. Those that have reference to the general constitutional condition of the patient. 2. Those that are connected with the operation itself.

1. To the first class may be referred the influence 1, *age;* 2, *general health;* and 3, *hygienic conditions.*

1. *Age* exercises a material influence on the result of amputations. As a general rule it may be stated that the younger the patient the greater the likelihood of a successful result. At early periods of life also there is a great exemption from low secondary diseases of the erysipeloid type, and if death occurs it is usually from exhaustion or intercurrent visceral mischief.

2. *The general health of the patient* previous to the operation exercises necessarily a more important influence on the chances of recovery. The result of amputations is necessarily widely different, according as the operation is practised on the healthy inhabitant of a country district, or on the cachetic and debilitated denizen of a large town. The causes of death also differ in these cases. In the country hemorrhage or acute inflammation, in towns erysipeloid diseases and pyemia commonly lead to the fatal result.

3. The *hygienic conditions* that surround the patient after the operation exercise, perhaps, an equally important influence, not only on the rate of mortality, but on the cause of death. Exposure to an impure atmosphere, want or

bad quality of food after an amputation, lessen materially the prospect of recovery by disposing the patient to the worst forms of erysipelas, pyemia, and hospital gangrene.

2. The circumstances connected with the operation itself that influence materially its results, are, 1. The *seat* of the amputation. 2. The *structure of the bone* sawn. 3. Whether the operation is done for *injury or disease.* 4. If for disease, the *nature* of the affection. 5. If for injury, the *time* that has elapsed before the limb is removed.

1. With regard to the influence of the *seat* of amputation on the result of the operation, it may be stated as a general rule, that the risk is greater in proportion as the size of the part that is amputated increases, and as the line of amputation approaches the trunk. In the larger limbs, more especially in the thigh, every inch appears to make a difference in this respect. Thus in our army in the East, of 178 amputations of the thigh 44 were in the upper third, and of these 38, or 86 per cent. proved fatal; 68 were in the middle third, of these 41, or 60 per cent. died; whilst in the lower third the mortality out of 66 cases was 37, or 56 per cent. It needs no formal argument to show, that the amputation of the toe, or of the foot, is less hazardous than that of the leg, or of the thigh. The statistics collected by Malgaigne of amputations of all kinds in the Parisian hospitals, exhibit clearly this increase in the ratio of mortality as the operation approaches the trunk. Thus, in 26 cases of amputaion of one of the smaller toes, there was 1 death. In 46 cases of amputation of the great toe, there were 7 deaths, or 1 in 6. Of 38 partial amputations of the foot, 9 proved fatal, or about 1 in 4. Of 192 cases of amputation of the leg, 106 died, about 56 per cent. And in 201 amputations of the thigh, there were 126 deaths, or 62 per cent.

I am informed that in the British army in the Crimea the per centage of death was, after amputation of the fore-arm 7, of the upper arm 19, of the shoulder joint 35; of the foot 16, of the leg 37, of the thigh 64, and of the hip 100, figures most creditable to the skill of the surgeons employed, but showing the progressive tendency to increase with the size of the limb removed.

Not only does the size of the part removed, and its proximity to the trunk, influence materially the general mortality after amputation; but these conditions also influence the particular cause of death. Thus, after the smaller amputations, as of a toe, for instance, death only occurs in unhealthy states of the constitution, from the occurrence of erysipelas, or of some of the various forms of diffuse inflammation. Death after the larger amputations more frequently results from causes connected with the operation itself, as, for instance, secondary hemorrhage, shock or exhaustion from the abstraction of the large quantity of blood contained in the limb, as well as by that lost during the operation. After the removal of the whole of a limb, as in the case of amputation of the hip-joint, it is possible that the cause suggested by Mr. Cox, viz., the removal of a limb in which the blood undergoes changes of importance to the rest of the economy, and consequently causing a return of imperfectly altered blood to the heart, may materially affect the result.

2. The *part of the bone* that is sawn through may influence the result. Thus amputations through the cancellous ends of long bones are less dangerous than those through their shafts, in consequence of the medullary canal not being opened when the section is made near the articular end, and thus the liability of diffuse suppuration of this cavity, and of consecutive phlebitis and pyemia are avoided.

3. The *nature of the disease* for which the amputation is performed influences its mortality. Thus amputations for malignant disease are more fatal than those for caries of bone or diseased joints. In cases of diseased joint there is a greater tendency to recover when the affection is of a simple than when it is of a tuberculous nature. The period at which the amputation is performed

after the setting in of the disease serves but little to influence the mortality, provided it be not deferred to too late a stage,—when the patient's constitution is worn out by hectic.

4. The mortality resulting from amputations is perhaps more directly influenced by whether the operation is done for injury or disease, than by any other cause, being far greater in corresponding limbs after injury than disease. In the following table may be seen the results of 174 cases of amputation performed at University College Hospital.

RESULT OF AMPUTATIONS IN UNIVERSITY COLLEGE HOSPITAL.

	Injury.		*Disease.*	
SEAT OF AMPUTATION.	CASES.	DEATHS.	CASES.	DEATHS.
Thigh	23	14	46	9
Leg	17	3	48	8
Shoulder and Arm .	7	2	16	5
Fore-arm	6	0	11	0
Total.	53	19	121	22

Of these amputations, 66 occurred in the Hospital up to 1841, and are reported by Mr. Potter in a paper published in the "Medico-Chirurgical Transactions for that year. They were performed by the several surgeons of the Institution at that time. Of the remaining 108, 41 were performed by Mr. Liston, between 1841 and his death, in 1847; 5 by his immediate successors; and 62 by me. Mr. Quain's cases are not included.

Malgaigne's statistics from the Parisian hospitals illustrate this matter in as clear a point of view, as will be seen by reference to the following tables.

	Injury.		*Disease.*	
SEAT.	CASES.	DEATHS.	CASES.	DEATHS.
Thigh	46	34	153	92
Leg	79	50	112	55
Foot	9	6	29	3
Arm	30	17	61	4

The shock inflicted by the injury, with its subsequent evils, appears to be one of the principal reasons of the greater frequency of the mortality after amputations for injury than of those for disease. After amputation for injury, also, there is a greater liability to the occurrence of gangrene of the stump, and pyemia and its secondary effects, than in the case of the removal of a limb for disease; in which the principal causes of death usually appear to be exhaustion, and the supervention of disease of the lungs. In amputation in cases of disease, it will be found, that those patients do best in whom the disease is most chronic. This is especially observable in cases of disease of bones and of the joints.

5. In amputation in cases of injury an important question has to be determined, viz., the influence exercised by the *time* that has elapsed from the infliction of the injury to the performance of the amputation, on its results. Not only is the rate of mortality influenced by the period at which the operation is performed, but the conditions that immediately occasion the fatal event; as Mr. James, of Exeter, has shown in a most excellent essay on the causes of death after amputation.

Amputations for injury are commonly divided by surgeons into *primary* and *secondary*; the *primary* being those that are performed during the first twenty-four or thirty hours, before any inflammatory action in the part injured has taken place. By *secondary* amputation, many surgeons mean those operations that are practised after the first twenty-four hours; whilst others again restrict the term to those that are done after suppuration has set up in the limb, calling those amputations *intermediate* that are performed between these two periods, viz., from the twenty-fourth hour to the occurrence of suppuration, and which consequently occupy a very extensive range. I think, however, that this distinction is a somewhat trivial one, and not very easily applied in practice; and it is better to include under the term *secondary*, all amputations performed after inflammatory action has been set up in the injured part. In civil practice, the mortality after primary amputations, as will be seen by the annexed tables, somewhat exceeds that following secondary operations. It is more especially primary amputations of the lower extremities, and particularly those of the thigh, that are attended by very fatal results. Of the 44 cases of primary amputation of the thigh, recorded by Malgaigne, 34 perished. And of 24 cases recorded by South, Laurie, and Peacock, as occurring at St. Thomas's Hospital, at the Glasgow Infirmary, and the Edinburgh Infirmary, every one proved fatal. This similarity of result occurring in different institutions, shows clearly that this operation is one of the most fatal in surgery, and that the great mortality attending it is inherent to it, and not dependant upon local or accidental circumstances. This danger of amputation of the thigh for injury is increased in proportion as the limb is severed high up. It is least in those cases in which the operation is done for injury of the leg or knee joint, and greatest when it is performed for compound fracture of the femur, recovery from which is rare indeed.

Primary Amputations.				*Secondary Amputations.*			
	CASES.	DEATHS.			CASES.	DEATHS.	
Thigh.	13	8	James.	Thigh.	15	5	James.
	5	5	South.		18	15	Steele.
	11	11	Laurie.		24	16	Laurie.
	32	21	Steele.		2	0	Hussey.
	6	5	Hussey.				
Leg	18	7	James.	Leg	5	1	James.
	9	2	South.		19	13	Steele.
	22	15	Laurie.		5	3	Laurie.
	53	22	Steele.		2	0	Hussey.
	13	0	Hussey.				
Shoulder and arm	19	3	James.	Shoulder and arm	4	1	James.
	6	0	South.		16	9	Steele.
	26	13	Laurie.		14	7	Laurie.
	49	15	Steele.		1	1	Hussey.
	16	3	Hussey.				
Fore-arm	18	0	James.	Fore-arm	1	0	Hussey.
	1	0	South.				
	15	0	Laurie.				
	35	1	Steele.				
	15	1	Hussey.				

RESULTS OF PRIMARY AND SECONDARY AMPUTATIONS IN CASES OF INJURY, AT UNIVERSITY COLLEGE HOSPITAL.

	Primary.		*Secondary.*	
SEAT.	CASES.	DEATHS.	CASES.	DEATHS.
Thigh	7	4	16	10
Leg	11	3	6	0
Shoulder and arm .	4	1	3	1
Fore-arm	5	0	1	0
Total . . .	27	8	26	11

In military practice the case is different; secondary amputations being by far more fatal than primary. This is the experience of army surgeons from the time of Faure, Larrey, and the Peninsular officers, to those of the late Crimean campaign. Thus, Faure only saved 30 out of 300 secondary amputations, whilst Larrey saved three-fourths of those in which he amputated primarily. In the Peninsular war, the mortality after secondary amputation of the upper extremity was twelve times, and after secondary amputation of the lower limb, three times as great as after primary amputation of these parts. I am informed on high authority that in the British army in the Crimea, from the 1st of April to the close of the war, the relative rate of mortality *per cent.*, after primary and secondary amputations, was as follows:

After *primary* amputations at the shoulder, 27; of the arm, 17; of the fore-arm, 3; of the thigh, 62; of the leg, 30; and of the foot, 17.

After *secondary* amputations the deaths *per cent.* were—at the shoulder, 66; of the arm, 31; of the fore-arm, 28; of the thigh, 80; and of the leg, 76. Or, for the upper extremity, the whole rate of deaths after primary was 15, against 41, after secondary amputations; whilst, for the lower extremity, excluding the foot, it was 46 for the primary, against 78 *per cent.* for the secondary.

To what is this difference between the results of primary and secondary amputations in civil and military practice owing? Why are the results of amputations reversed in civil and military practice? Why are primary amputations more fatal in civil, and secondary amputations in military practice? I think we may explain this difference in respect to primary amputations, partly by the circumstances under which the injury of the limb has been received, and partly by the difference in the nature of the accident. As has already been stated, the shock to the system is the main cause of death after primary amputations, and this is felt less severely by the soldier than by the civilian. A soldier struck in the heat of action, when his spirits are raised, and his courage is high, treats his wound almost with indifference, or looks upon it, perhaps, as a glorious accident of his profession; whilst the civilian, whose limb is crushed by the wheel of a carriage, or the fall of a scaffold, is not only mentally unprepared for such an accident, but is depressed by the magnitude of the calamity that has unexpectedly overtaken him, in which he sees, perhaps, his own ruin and that of his family. Hence, the depressing influence of the shock of the injury is seriously increased by the mental distress accompanying it, and the chances of recovery are proportionately diminished.

In secondary amputations the influence of shock is no longer felt, but the chief danger arises from the occurrence of gangrene, diffuse inflammation, secondary hemorrhage, and all those morbid conditions that are apt to be induced by defective hygienic circumstances, and in these respects the civilian is more favorably situated than the soldier. If an injured limb be not removed on the field, the soldier is often conveyed to a crowded hospital, necessarily overfilled with wounded comrades, and rife with pestilential influences,

where, if amputation is performed, he has little prospect of escaping infection. The civilian, on the other hand, who is struck down by accident, is placed in a state of cleanliness and comfort — probably greater than he has ever before experienced — can be successfully guarded against all noxious influences, and consequently has the best possible chance of recovery afforded him. In addition to this, amputations are not uncommonly very properly done on the field, in cases in which an attempt would be made in civil practice to save the limb, and as the injuries are frequently produced by musket-shot, there is less mangling of the limb, and consequent shock to the system, than when a member is crushed by those accidents in mines, on railways, and by waggons, for which primary amputation is commonly required in civil life.

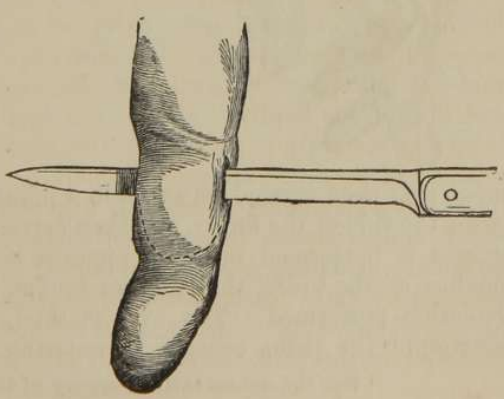
As has already been observed, not only does the rate of mortality differ in primary and secondary amputations, but also the cause of death. Primary amputations are most frequently fatal from shock or exhaustion, although death from secondary diseases of a low type is by no means of unfrequent occurrence in these cases. Secondary amputations for injury most commonly carry off the patient by the supervention of diseases of a low type. Amongst these secondary affections that are, according to my observation at the University College Hospital, of most frequent occurrence, gangrene of the stump stands in the first place, especially after amputation of the thigh, and more particularly if the limb has previously been in a similar condition before the amputation. Then again phlebitis with pyemia, secondary hemorrhage, and some of the low forms of visceral inflammation, or congestion, as pneumonia, pleurisy, and diarrhœa, are of frequent occurrence. Pyemia and congestive pneumonia are the most frequent causes of death after secondary amputation of the leg and arm. Secondary hemorrhage to such an extent as to prove fatal is not of common occurrence; when it does happen it is usually associated with some diseased state of the blood that interferes with the formation of a plastic plug in the artery. The treatment of this condition will be considered in discussing injuries of arteries.

CHAPTER III.

SPECIAL AMPUTATIONS.

AMPUTATIONS OF THE HAND.—*The fingers* not unfrequently require amputation for injury or disease, more especially as the result of bad whitlow. In many cases the ungual phalanx requires removal, having become necrosed. This may usually most readily be done without amputation by making an incision through the pulp of the finger, and then extracting the diseased bone, thus saving the nail and pulp, which will form an excellent end to the finger. Yet, in other cases amputation will be required. This may either be done by cutting into the joint from its dorsal aspect with

FIG. 6.



a narrow-bladed bistoury, running across it lightly, touching the lateral ligaments, and making the flap from the palmar aspect; or the flap may conveniently be made from the palmar surface by transfixion, and then cutting cross the joint (Fig. 6).[1] In doing this, care must be taken not to get too far backwards, and to mistake the depression above the head of the second phalanx for the articulation, which would lead to a little embarrassment. Some little difficulty is occasionally experienced in finding the joint, and surgeons have endeavored to be guided to it by attention to the folds in the integument covering it; but in these there is no constancy, and no correlation exists between the joint and the folds in the skin over it. When the amputation is performed from the dorsal aspect the finger should be flexed, when the joint will be found immediately under the apex of the triangle formed by the phalanges. In operating from the palmar aspect, the finger should be forcibly extended as soon as the flap is made, when if the knife be applied to the lateral ligaments the synovial surface will show itself; but, as a general rule, amputation should not be performed between the proximal and second phalanges; because as no flexor tendon is attached to the proximal phalanx, it is apt to remain permanently extended, and a good deal in the patient's way. In the case of the index finger, however, it will be better to leave the proximal phalanx, the stump of which forms a useful opponent to the thumb.

Fig. 7.

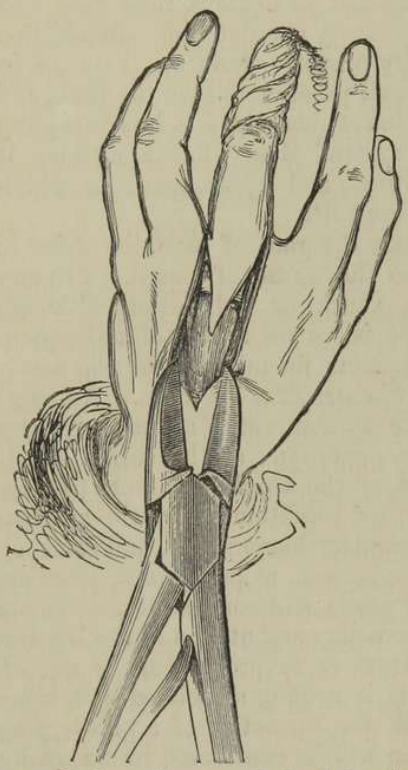
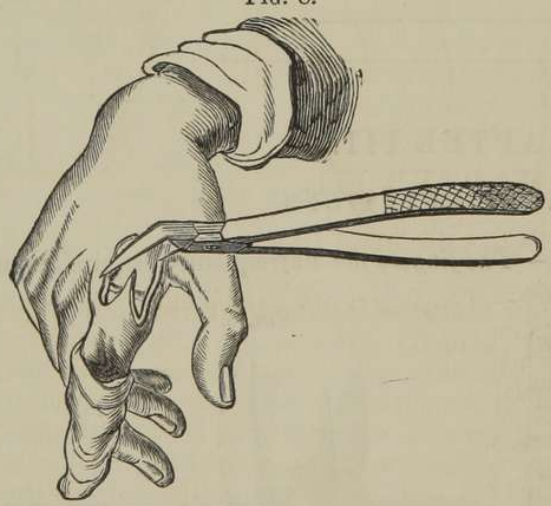


Fig. 8.



Amputation is frequently required at the *metacarpo-phalangeal articulations.* Here it may be done in two ways; either by lateral flaps, or the oval method. If by lateral flaps, the adjoining fingers should be well separated from the one about to be removed, by an assistant who grasps the hand, so as to put the integument on the dorsum upon the stretch. The point of a bistoury should then be entered about three-quarters of an inch above the head of the metacarpal bone; it is then carried forwards to a point opposite the interdigital web, drawn across the side of the finger, and then carried a little way into the palm. The same process is performed upon the opposite side, the flaps dissected down by a few touches of the knife, the extensor tendon divided, the joint opened, and disarticulation performed. The oval method, which I think is the best, as it does not wound the palm, consists in entering the bistoury at the same point as in

[1] For the conservative surgery of the hand, *vide* Chapter XLIV.

the last case, carrying it as far as the web, drawing it across the palmar aspect of the finger, and then obliquely backwards to join the starting-point of the incision. By a few touches of the point of the knife the oval flap is turned back, and the articulation opened. As a general rule it is better to remove the head of the metacarpal bone together with the finger, as otherwise a wide gap will be left in the situation of the finger that has been amputated, and much deformity of the hand result. This may be done by cutting the metacarpal bone beyond its head across with bone-forceps in a transverse direction, if it be either the middle or ring-finger that is removed (Fig. 7). If it is the index or little finger, the bone should be cut obliquely from without inwards, so as to shape the bone to the tapering form of the hand (Fig. 8). If it be cut directly across, an ugly and inconvenient square protuberance will always be left, which will be much in the way, and liable to constant injury. In some employments, however, in which great strength and breadth of hand are required, and where appearance is of little consequence, the head of the bone may advantageously be left.

The after-treatment of these cases is extremely simple. The hand should be put upon a splint, the wound covered with a piece of water-dressing, and the ends of the fingers, with a small piece of lint interposed, tied together by means of a tape, care being taken, however, that they do not overlap. The shaft of the metacarpal bone that is left will gradually atrophy, and thus a very taper and shapely hand eventually be left (Figs. 9, 10, and 11).

Fig. 9.

Fig. 10.

Fig. 11.

Amputation of the Thumb. — In disease or injury of the thumb as little as possible should be removed by amputation, for if even but a very short stump of the metacarpal bone is left, it will serve as a useful opponent for the other fingers. When the thumb requires amputation, it may most conveniently be removed by Liston's method. The point of a long narrow bistoury should be introduced well on the palmar aspect of the carpo-metacarpal articulation, carried over this, which it opens (Fig. 12), and the dorsum of the hand as far as the web; the point of the knife should then be pushed downwards through the ball of the thumb, transfixing this and issuing where the incision commenced. It is next made to cut outwards, keeping close to the metacarpal bone, which is readily twisted out, the remaining attachment being separated by a few touches of the knife. A oval incision will be left, which comes together closely by a narrow line of cicatrix. In amputating the right thumb, it will be necessary for the surgeon if he adopt the method just described, either

to use his left hand, or to cross his hands in an awkward manner. In order to avoid doing this, he may reverse the steps of the operation with advantage; first transfixing the ball, and making the anterior flap, then cutting over the dorsum, opening the joint, and turning out the bone (Fig. 13).

Fig. 12.

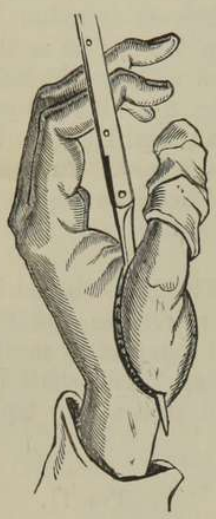


Fig. 13.

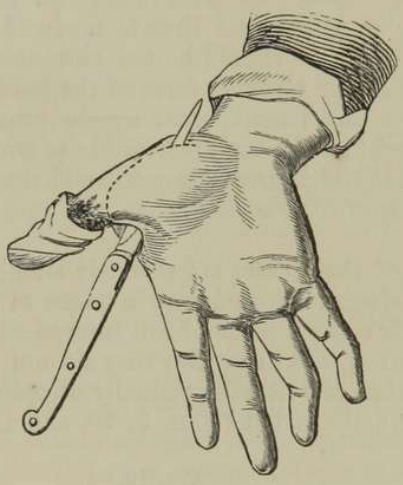
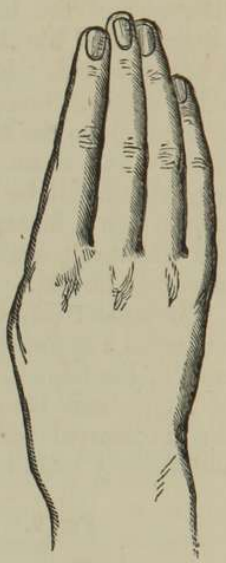


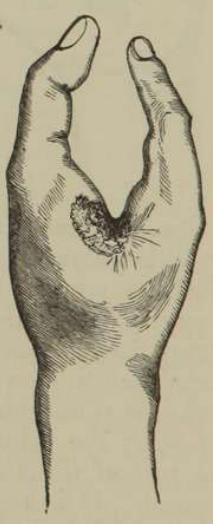
Fig. 14.



The metacarpal bones, with or without the fingers supported by them, occasionally require removal for disease or injury. For these operations, which are not of a very regular kind, it is difficult to lay down definite rules; but in performing them, care should be taken to make good square flaps of sufficient size, but to avoid cutting into the palm if possible. It is well not to disarticulate the lower end of the bone, so as to open the wrist-joint, but rather to cut it off with bone-forceps a little above this. In injuries from the explosion of powder-flasks or gun-barrels, when the hand is much shattered, it is of great consequence to avoid cutting up the palm to too great an extent, and it is well, in these cases, to save a finger if possible, which will be more of use to the patient than any artificial limb, however ingeniously constructed (Figs. 15 and 16). When only one finger is left, as the index or little finger, with the thumb, in cases of partial amputation of the hand after injury or for disease, the digit that remains not only becomes more mobile than formerly, but greatly increased in size and much stronger than before, so that its utility becomes materially augmented.

Fig. 15.

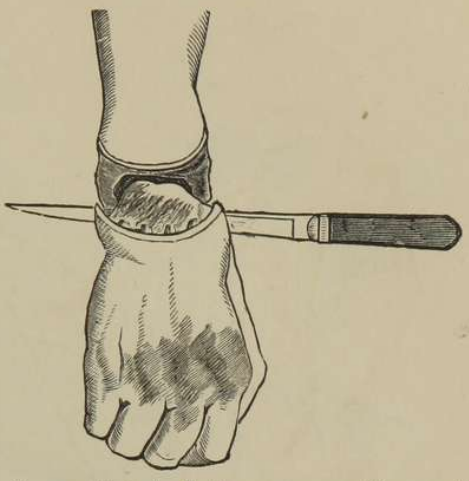
Fig. 16.



Amputation at the wrist is not very often required. In performing disarticulation at this joint, its peculiar shape with the convexity looking upwards must be borne in mind. The integuments being well retracted, an

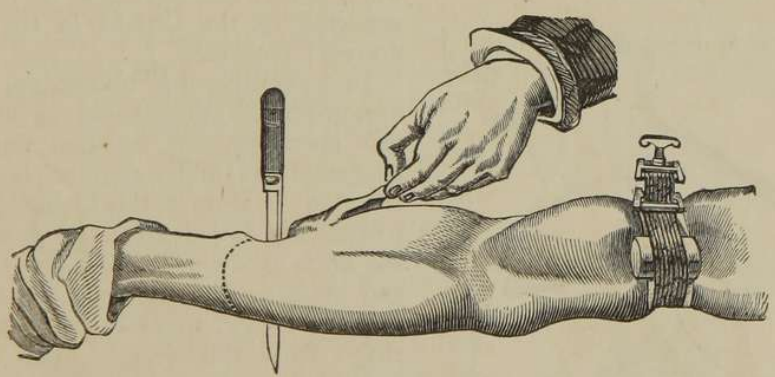
arched incision should be made from one styloid process to the other, across the back of the joint, with its convexity looking forwards (Fig. 17). The articulation having been opened, and the lateral ligaments divided, the knife is carried forwards so as to make a well-rounded flap from the palmar surface; in doing this, care must be taken not to cut against the pisiform bone; which projects a good deal beyond the other carpal bones.

Fig. 17.



Amputations of the Arm. — *Amputation of the forearm* is not unfrequently required for disease or injury of the wrist or hand. In performing this operation, as long a stump should be left as possible, so as to give the patient more power over any artificial limb that may be fitted to it. The flaps should be about a couple of inches in length, and well rounded, the hand being placed in a midstate between pronation and supination. The dorsal flap is best made by cutting from without inwards; the line of incision commencing just at the palmar aspect of the under part of the ulna, being carried forwards for a little distance parallel to this bone, and then across the arm in a slightly curved manner, until it reaches the palmar aspect of the radius; it must then pass along this, until it reach a point opposite to that at which it commenced, and be dissected back. The palmar flap is next made by transfixion (Fig. 18). As soon as it is cut, the bones are cleared

Fig. 18.



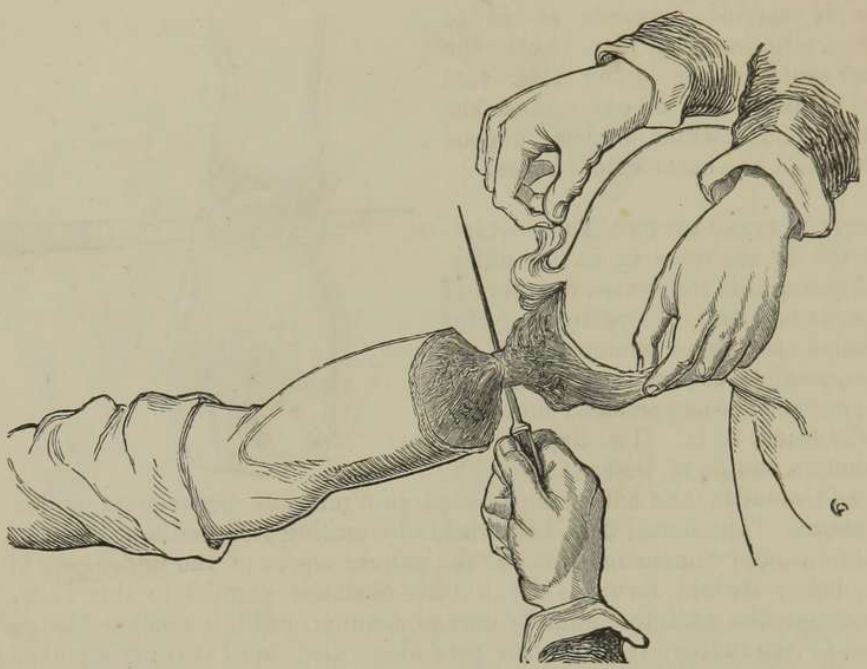
by a couple of sweeps of the knife, and the interosseous membrane divided, they are then sawn together. The vessels will be found to be cut long at the end, and on either side of the palmar flap.

Amputation of the arm is most readily performed by lateral flaps made by transfixion from before backwards; the bone is then well cleared by a couple of sweeps of the knife and sawn across. In clearing the bone, care must be taken fairly to divide the musculo-spiral nerve by a firm sweep of the knife round the back of the bone (Fig. 19), if the amputation is performed in that part of the arm where this nerve winds round the humerus. If the limb is very muscular, skin flaps and the circular section of the muscles will probably give the best result.

Amputation at the shoulder-joint may be required for injury of the arm or

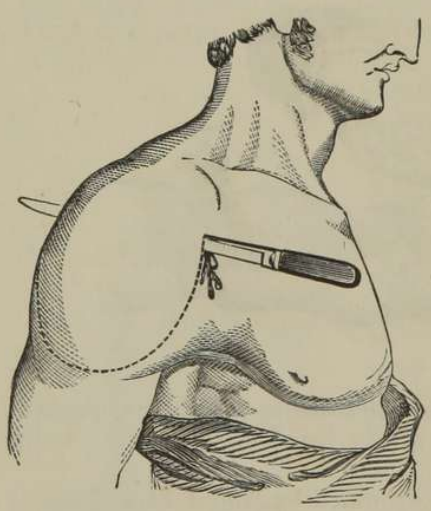
disease of the humerus; in the first case it is best performed by transfixion; in the other, by cutting from without inwards. The subclavian artery should be

Fig. 19.



compressed as it passes over the first rib; though, if the assistant be steady and well up to his duties, this may be dispensed with.

Fig. 20.



The operation, for so severe a procedure, is very successful; of 60 cases that occurred in the Crimea in the British army 41 recovered.

In operating by transfixion, a long narrow-bladed knife should be used. In this operation, one assistant must have charge of the limb; another should raise the flap; and to a third should be entrusted the important duty of following the knife as it cuts behind the humerus, and grasping the posterior flap with the axillary artery, so as to prevent hemorrhage from this vessel. The assistant holding the arm away from the body, so as to relax the deltoid somewhat, the knife, instead of being entered by a puncture, should make a small cross-cut about an inch in extent, at the point at which transfixion is to be practised, so as to prevent that jagging of the integuments by the heel of the instrument which would otherwise occur. If the operation be on the *right* side, the surgeon stands before the patient, and the point of the knife should be entered about an inch in front of the acromion (Fig. 20); and being carried directly across the joint and capsule, should pass out at the posterior border of the axilla. If on the *left* side, the surgeon stands behind, and the point of the knife must be entered well behind the spine of the scapula, at the posterior border of

the axilla, carried across the anterior aspect of the joint, and brought out to the inner side of the coracoid process. In either case the large flap containing the deltoid muscle must then be cut by a sweep of the knife downwards, and as soon as made, raised by another assistant. The heel of the knife is now to be laid on the head of bone, the capsule of the joint cut across, and the attachments of the muscles to the tuberosity divided. In order to facilitate this part of the operation, it is generally recommended that the arm should be carried forcibly inwards across the chest. This may readily be done in the dissecting-room where the limb is entire; but in the case of comminuted fracture of the humerus, with extensive laceration of soft parts, it cannot be accomplished. In such cases as these, the head and upper end of the humerus being broken off from the shaft, the lever-like action of the bone cannot be put in force, and it is sometimes not such an easy matter as might at first appear, to detach its head from the glenoid cavity. In order to do this, I have in cases of comminuted fracture of the humerus, in which I was amputating at the shoulder-joint, found it necessary, after opening the capsule, to seize hold of the upper fragment and to draw it forcibly downwards and inwards, by inserting the fingers between the head and the glenoid cavity, in order to divide the muscles inserted into it. After the head of the bone has been turned out of the glenoid cavity, the knife must be passed behind it, and carried down for a distance of about three inches close to the bone at its inner side. The surgeon then cuts across the soft parts, so as to form the posterior flap. In doing this, the assistant, to whom this duty is entrusted, must follow the knife with his hands, grasping firmly the whole thickness of the posterior flap, so as to compress the axillary artery, and thus prevent the occurrence of hemorrhage (Fig. 21). The

Fig. 21.

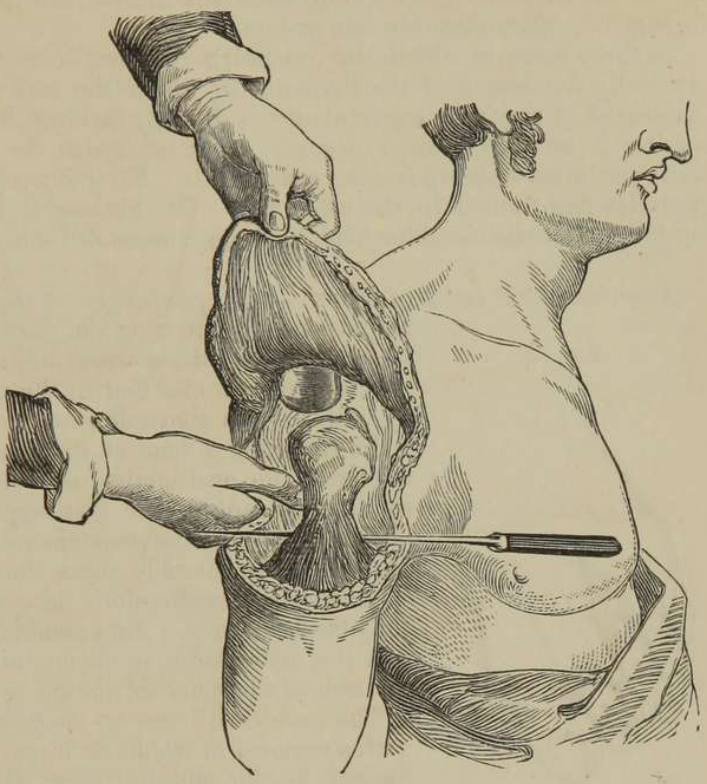


Fig. 22.

surgeon should not cut the flap across until the assistant tells him that he holds the vessel firmly, and then he must be cautious not to injure his assistant's fingers. The artery will be found to be cut long in the middle of the posterior flap, and a few smaller branches may be required to be tied at its inner angle and in the deltoid. The stump, after it is healed, will present the appearance in Fig. 22, taken from my last patient.

In those cases in which this operation requires to be performed for disease, especially for tumors of the humerus, by which the soft parts are thinned or condensed, it may very conveniently be done by making the anterior flap by dissecting it up from without inwards, using of course for this purpose a short knife; a broad bistoury is most convenient. The joint is then opened, and the posterior flap formed in the usual way. In this way I have easily performed amputation at the shoulder joint for large tumors of the head of the humerus.

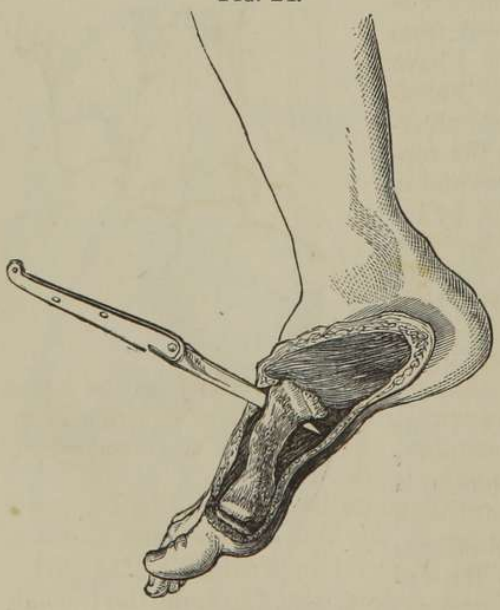
AMPUTATIONS OF THE FOOT. — *The phalanges of the toes* seldom require amputation; when they do, they may be removed in the same way as the corresponding parts in the hand — by the formation of a flap on the plantar surface, either by cutting from above downwards, or by transfixion.

FIG. 23.

In removing a bone at the metatarso-phalangeal articulation the oval method should always be practised, so that the sole of the foot may not be cut into. In doing this, it must be remembered that the articulation is situated considerably above the web of the toes, and the incision must therefore be commenced proportionately far backwards. As a general rule it will be found that the articulation is about the same distance above the web as the point of the toe is below it.

The *metatarsal bone of the great toe* occasionally requires removal in whole or in part. If the disease is limited to the anterior part, the shaft of the bone should be cut across with a pair of bone-nippers, and its head left; for as this gives insertion to the peroneus longus, its removal will materially weaken the foot. The whole of the bone may be readily removed in the following way: the point of a strong broad bistoury should be entered on the dorsum of the foot in the interspace between the first and second metatarsal bones, as far back as possible; it should then be carried forwards upon the ball of the great toe, to a point opposite to the web between the toes, and thence made to sink into the sole of the foot in a line parallel with the outer margin of the bone (Fig. 24); the flap thus formed should be dissected back, its plantar aspect being kept as thick and fleshy as possible. The surgeon next passes the knife between the first and second metatarsal bones, and cuts directly forwards through the centre of the angle between the great and the second toes. In doing this, care must be taken that the edge of the knife is not directed too much towards the metatarsal bone of the great toe, lest it hitch

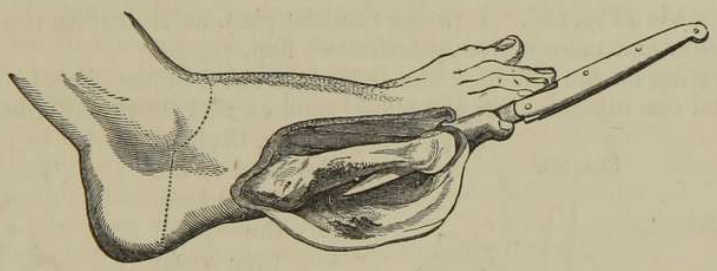
FIG. 24.



against one of the sesamoid bones. The surgeon next seizes the extremity of the toe, and, pressing it well inwards, passes the point of the bistoury deeply into the angle of the wound (Fig. 24), where, by the division of some tendinous and ligamentous fibres that constitute the key of the joint, he opens the articulation and detaches the bone by lightly touching its ligamentous attachments. By keeping the edge of the knife well against the side of the bone, he may avoid wounding the dorsal artery of the foot, the bleeding from which would be troublesome. When the bone is to be partially removed, the operation requires to be performed in the same way, the incisions, however, not being carried so far backwards.

The *metatarsal bone of the little toe* may conveniently be removed by an oval incision, so as to avoid wounding the sole of the foot. This is best done by entering the point of the knife just behind the tubercle of the bone, carrying it forwards and inwards in the line of its articulation with the cuboid, to the centre of the fourth digital interspace, and thence forwards to the web of the toe; the knife is next carried round the plantar surface of this, the incision being continued obliquely into that which has been made on the dorsum of the foot (Fig. 25). The small flap thus formed is well dissected down, the knife

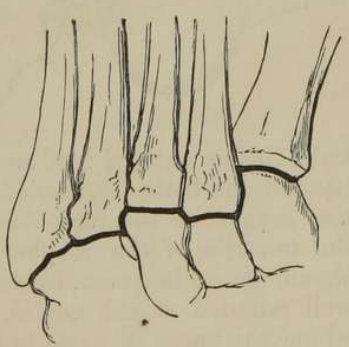
Fig. 25.



passed round the under surface of the bone, and the joint opened by the toe being forcibly drawn outwards, and its ligamentous connections lightly divided.

The *whole of the metatarsal bones* may be removed from the tarsal, by the operation originally planned and executed by Mr. Hey. This consists in, first of all, making a large convex flap in the sole of the foot, one horn of which commences at the tubercle of the fifth metatarsal bone, whilst the other terminates at that of the first, or rather opposite the projection of the scaphoid. A small flap is then made on the dorsum of the foot, and the articulations exposed. These must then be opened with some care, as they are very irregular (Fig. 26); the second metatarsal bone, especially, being sunk into a kind of pit in the middle cuneiform, and the articulation of the fifth with the cuboid being very oblique. This operation is seldom practised, disease being rarely limited to the metatarsal bones; their disarticulation also from the tarsus is very troublesome, on account of the irregularity of the line of articulation, hence it is better to saw through the metatarsus just in front of the tarsal articulations, rather than to attempt to disjoint the bones.

Fig. 26.



Amputation through the tarsus may conveniently be performed by Chopart's operation, which consists in disarticulation in the line between the os calcis and astragalus behind, and the cuboid and scaphoid in front (Fig. 27). This operation may be performed either by first making the flap from the sole of

Fig. 27.

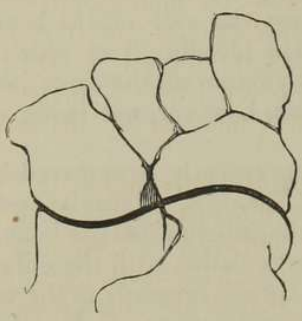
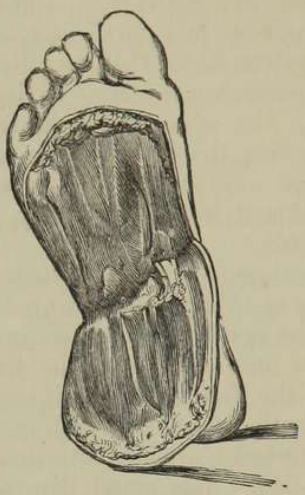


Fig. 28.



the foot, and then disarticulating (Fig. 28), or the procedure may be reversed, and the joints having been cut through from the dorsum, the flap may afterwards be made (Fig. 29). I prefer the first plan, as it enables the surgeon to make a better and more correctly-fashioned flap.

In operating on the left foot, the knife, a stout bistoury, should be entered well behind the tubercle of the scaphoid, and carried forwards for at least three inches, to about the head of the metatarsal bone of the great toe, then right across the sole and down the outer side of the foot, as far as half an inch behind the fifth metatarsal bone. On the right foot, this line of incision is reversed by the knife being entered half an inch behind the metatarsal bone of the little toe, carried forwards to the root of the toes across the sole, and down the inner side to behind the tubercle of the scaphoid (Fig. 30, 2). This flap should be made broad, especially at the inner side, but well rounded at the angles, and should consist of the whole thickness of parts in the sole of the foot, which must be well dissected out from the concavity under the metatarsal bone. A convex incision is then made along the dorsum from one horn to the other of the plantar flap; the parts well retracted, and the articulations opened by the surgeon bearing firmly upon the anterior part of the foot, and lightly touching the ligamentous structures with the point of his bistoury. In this stage of the operation, care must be taken that the edge of the bistoury be not inclined too much backwards, lest it slip over the astragalus and open the ankle-joint; or too far forwards, lest it pass anterior to

Fig. 29.

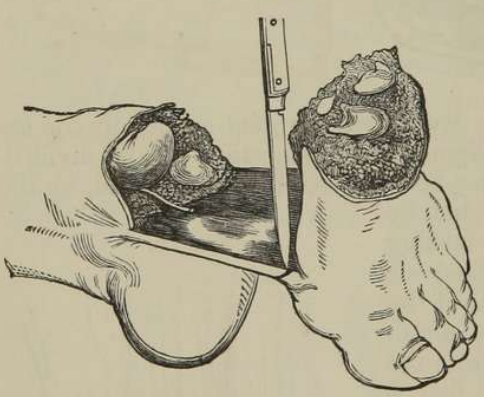
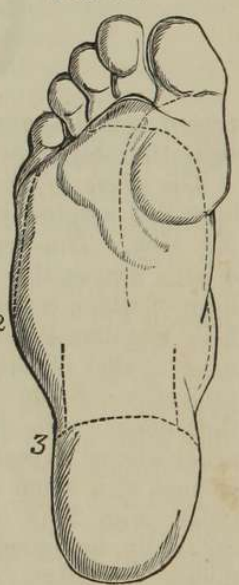


Fig. 30.



1. Line of amputation of great toe.
2. Line of Chopart's operation.
3. Lines for excision of os calcis.

the scaphoid — between it and the cuneiform bones. After disarticulation has been produced, the projecting head of the astragalus should be sawn or clipped off. The result of this operation is extremely favorable, the patient, by the aid of a properly constructed boot, being able to walk, and even dance with very little appearance of lameness. In some cases where the muscles of the calf are very strong, and calcaneum projecting, the heel becomes drawn up, and the centre edge of the stump made to point down in such a way that the patient is rendered lame by walking on the anterior sharp edge of the calcaneum, which irritates the flap. This condition is best removed by division of the tendo Achillis.

Disarticulation of the foot at the ankle-joint was first reduced by Mr. Syme to a regular operation. By its performance amputation of the leg may often be avoided, the patient being left with an exceedingly useful stump, which, as its covering is ingeniously taken from the heel, constitutes an excellent basis of support (Fig. 34) The operation is performed by making an incision from the anterior part of one malleolus downwards and backwards, across the plantar surface of the heel, to a corresponding point in the opposite malleolus (Fig. 31). This flap is well dissected back, the knife being kept close against the bone, especially when it passes towards the inner side of the os calcis, in the neighborhood of the plantar arteries (Fig. 32). An incision is next made across the dorsum of the foot, from the upper extremity of the sole flap on one side, to that on the other, and the joint opened from the front. The lateral ligaments should now be touched with the point of the bistoury, and the tendo Achillis divided by pressing the foot forcibly downwards and cutting from before backwards (Fig. 33) by some twisting and dissection; at the same time the os calcis is completely separated from its soft attachments, and the foot removed; the two malleoli must then be sawn off, the plantar arteries tied, and the flap brought up. A well-formed rounded stump will thus be left as represented in Fig. 34.

Fig. 31.

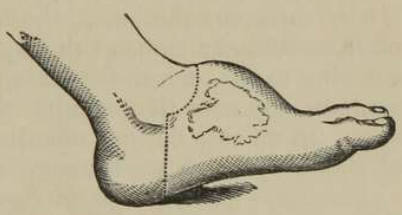


Fig. 32.

Fig. 33.

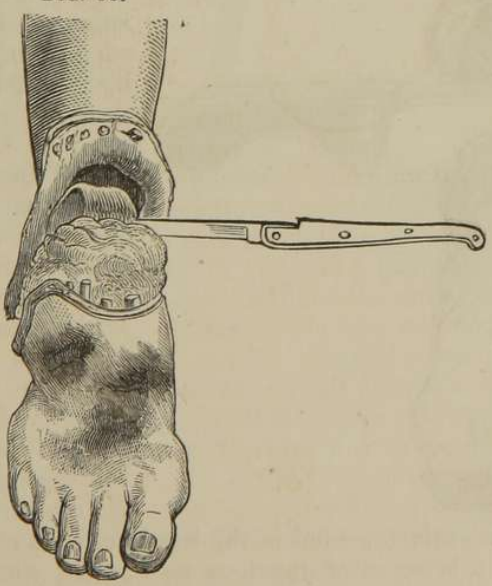
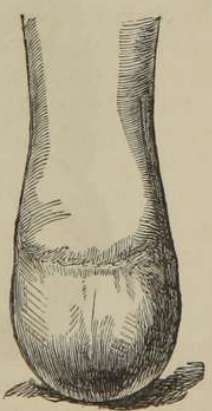


Fig. 34.



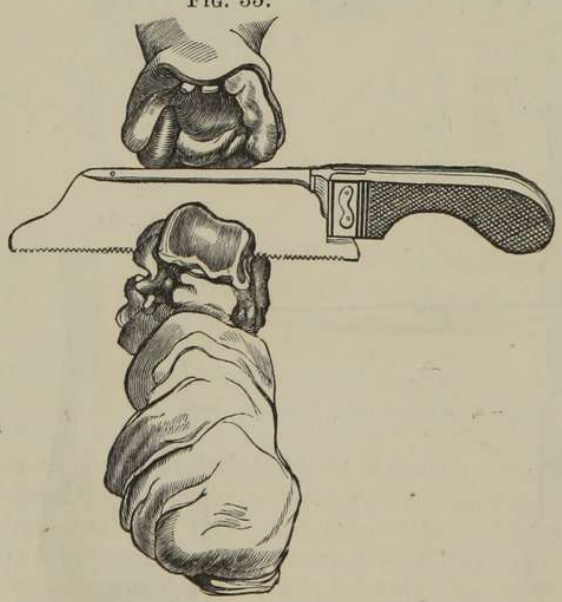
In performing this operation, care must be taken that no button-hole apertures are made through the posterior part of the heel flap. This may commonly

be avoided readily enough whon the soft structures in this situation are greatly thickened and infiltrated by plastic matter, as the result of chronic disease; but if the operation be required for injury of the foot, great care is required in digging out the heel, the integuments at the posterior part of the os calcis being very thin and adherent to the bone. It is also of importance that the incision across the heel should be carried well back over its point (Fig. 32). Unless this be done a large cup-shaped flap will be left, in which blood and pus will accumulate, and the cicatrization of the stump will be much retarded. The principal point, however, to be attended to is, that the plantar arteries are cut long; unless care be taken to do this, the flap will be insufficiently supplied with blood, and sloughing, especially of its outer angle, to which there is in all cases a tendency, will be particularly liable to occur. As union takes place by granulation, there will be a tendency to bagging in the stump, but this may be prevented by proper bandaging. The tendency to sloughing and to undue suppuration chiefly occurs in those cases in which the amputation has been performed as a primary operation for a crush of the foot. In one case, in which I had occasion to perform it for an injury of this kind, a good deal of trouble resulted from this cause, though eventually the case did perfectly well, and the patient now walks with scarcely any difficulty.

Various modifications of Syme's amputation may at times be practised with advantage, in consequence of the soft part covering the heel being more or less ulcerated or disorganized, so as not to admit of forming a good basis of support. Under these circumstances, the flaps may be fashioned from the sides instead of from behind; and in this way I have more than once formed an excellent covering to the end of the stump. These lateral flaps should not, however, be made in any case that admits of disarticulation at the ankle in the ordinary way. In no case do they afford so great a basis of support as the integuments of the heel, which are far more dense and elastic.

Pirogoff's modification of Syme's operation consists in the preservation of the posterior portions of the os calcis which is left in the heel flap. The operation is performed in in the following way: — the incision is carried across the sole of the foot, from one malleolus to another; but the flap thus formed is only dissected here about two lines. Disarticulation of the astragalus is then effected in the usual way by an incision across the front of the foot. A narrow saw is now applied to the upper and back part of the os calcis behind the astragalus (Fig. 35), and the bone cut obliquely downwards and forwards; the malleoli are then removed and a thin slice of the articular cartilage taken off. The advantages of this operation over the ordinary mode of disarticulation consist in the stump being larger and better adapted for pressure,—in the readiness of the union of the two applied osseous surfaces,—and in the less likelihood of the vascular supply in the posterior flap being interrupted, as its vascular communications are not much disturbed, and the posterior tibial artery can always be cut long.

Fig. 35.



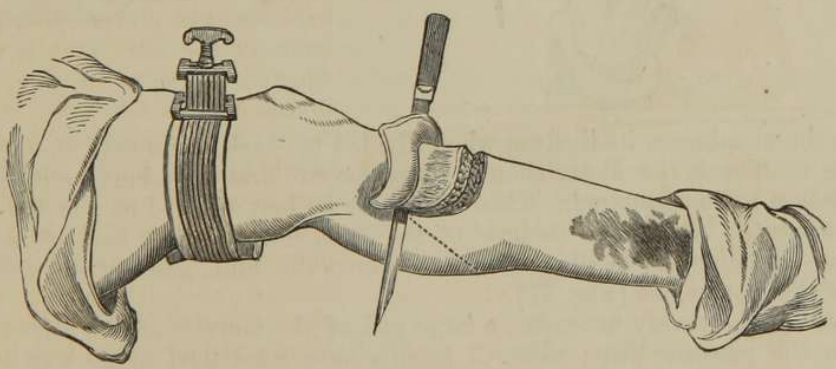
The Subastragaloid amputation is another mode of disarticulating the foot In it the heel flap is made as in Syme's operation, and the articulation between

the astragalus and scaphoid being opened (the ankle-joint left intact), the bistoury is passed under the astragalus, between it and the calcaneum, which, together with the rest of the foot, is removed. In this amputation a good, long, useful stump results; but the cases requiring it must be few, as it does not often happen that the calcaneum, together with the anterior range of tarsal bones are diseased, without the astragalus also being involved.

In cases of caries of the tarsus requiring amputation, it occasionally happens that the surgeon cannot determine with certainty, whether the morbid action is limited to the anterior range of tarsal bones, or extends so far backwards as seriously to implicate the astragalus and calcaneum, and is consequently unable to decide whether the foot admits of removal by Chopart's operation, or requires disarticulation at the ankle-joint. Under these circumstances all doubt will be cleared, and the proper operation performed, by making an incision across the dorsum of the foot in the line of the astragalo-scaphoid and calcaneo-cuboid articulations; these are then opened, and the state of the bones examined. If the astragalus and calcanenm be sound, or but slightly diseased on their anterior aspect, Chopart's operation may be done, and any carious bone left behind gouged away. If, on the contrary, these bones be found to be deeply implicated, the flap may be dissected back for about an inch, and disarticulation at the ankle-joint proceeded with. It may also be well to bear in mind, that the tarsal articulations may have become so anchylosed, as the result of old disease, as to require the application of the saw.

AMPUTATION OF THE LEG may be performed in three situations; either just below the knee, in the middle, or in the lower third of the limb. The selection of the line of amputation must depend upon the extent of the disease, but, wherever practicable, the amputation should be performed low down; the mortality diminishing in proportion as the limb is removed near to the ankle. Of 106 amputations in this situation done in Paris there were only 13 deaths. Surgeons used formerly, even where the disease or injury was limited to the foot, to amputate immediately below the knee; in all those cases in which the patient would be obliged to wear a common wooden pin, the long leg stump

FIG. 36.

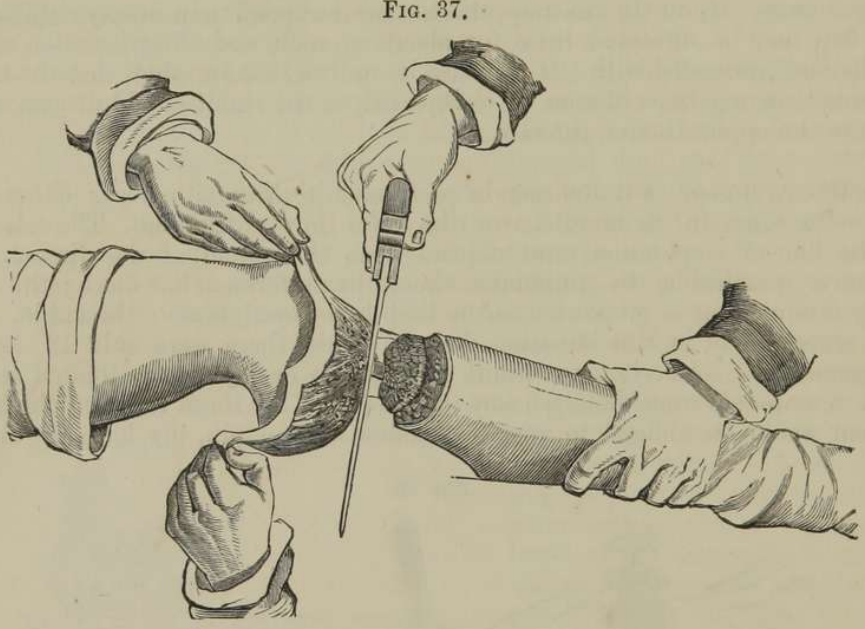


being highly inconvenient when the patient rested on his bent knee; whereas to those individuals who could afford the expense of a well-constructed artificial limb, the amputation was done in the lower part of the leg. But this difficulty has of late years been removed by the introduction of a short wooden pin, in the socket of which the stump is fixed in the extended position; and amputation in all admissible cases should consequently, even amongst the poorer classes, be done at or below the calf.

The flap amputation of the leg may be performed in the following way. The tourniquet having been applied to the artery in the popliteal space (Fig. 36),

the assistant, whose duty it is to retract the flap, takes his stand in this, as in all amputations of the lower extremities, opposite to the surgeon. In the left limb, the point of the knife is entered at the posterior edge of the tibia, carried forwards for a distance of one inch and a half, then across the anterior part of the leg to the posterior border of the fibula, up which the incision is made to extend to a corresponding distance. In the right leg, the same incision commences on the fibular side of the limb, and terminates on the tibial. The flap thus formed, which should be broad and well rounded, is next dissected up by a few touches of the point of the knife, and transfixion of the limb made by passing the blade across behind the bones, from one angle of the incision to the other. The posterior flap is then formed by cutting obliquely downwards and backwards, and should be about three inches long. The bones are next cleared by a double sweep of the knife, and the interosseous soft parts divided by carrying the instrument in a figure of 8 way between the bones. In doing this, especial care must be taken not to direct the edge upwards, so as to split either of the tibial arteries, more particularly the anterior: for as this vessel retracts

Fig. 37.



above the membrane, its ligature when divided too high, is no easy matter. In sawing the bones, the fibula should always be cut first, as otherwise it will be pretty sure to be splintered. This bone may be best divided on the left side, by sinking the hand below its level of the limb, and using the heel of the saw; and on the right, by holding the hand above the limb, and cutting with the end of the instrument (Fig. 37).

If the limb be very muscular, a large pad of the muscles of the calf will be left in the posterior flap; this will usually be a good deal in the way during treatment; it may slough, and thus interfere with proper union. In some cases, I have advantageously removed at one sweep of the knife the greater part of the muscular mass thus left, thus leaving little more than a skin-flap; but in order to avoid this, the best operation consists, in such cases as these, in forming skin-flaps on the anterior and posterior aspects of the limb, and then making a circular cut through the muscles. In this way the ends of the bones receive but a thin covering; but this matters little if the operation is performed just below the knee, for the patient bearing upon the anterior face of the stump, exercises no pressure upon its cicatrix when an artificial limb is adapted to it.

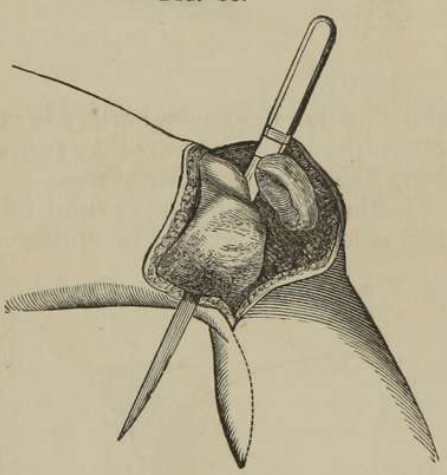
Amputation through the knee-joint, originally recommended by Hoin, and

practised by Velpeau and other Continental surgeons, has recently found favor in this country and America.

The operation may readily be performed in the following way. An incision is made directly across the knee-joint above the centre of the patella. The skin-flap thus formed is dissected back, and the joint being opened above the patella, and the ligaments divided by a few touches of the knife, a long posterior flap is cut from the upper part of the calf of the leg, by passing the knife behind the tibia and carrying it downwards for a suitable distance. The exposed articular surface of the femur is then to be sawn off. The only large vessel requiring ligature will be the popliteal. Some surgeons prefer making a long anterior skin-flap and a transverse cut through the soft structures of the ham. The anterior flap falls over the end of the femur, and being composed of the tough and extensile integument of the knee, constitutes an excellent covering to the bone well adapted for pressure.

This amputation may sometimes conveniently be varied by being done *through the condyles* without previously opening the knee-joint. The anterior flap is fashioned as before, the posterior flap is then made by transfixion behind the joint, and the bone being so cleared, the saw is applied immediately above the articulation, and the limb thus removed (Fig. 38). The result is the same in whichever way the operation is done The advantages of this operation over amputation of the thigh higher up are undoubtedly great. The limb being removed at a greater distance from the trunk, the shock to the system will be less, and the rate of mortality diminished. The medullary canal of the femur not being opened there will be less likelihood of osteomyelitis; fewer ligatures will be required, and if desirable these may be brought out through an opening made in the centre of the posterior flap, as Blandin recommends; and lastly, a longer stump will be left, the movements of which are more under the control of the patient than a shorter one, owing to the proper muscles of the femur not being divided, and thus all the movements of that bone being preserved in their integrity. There is a little point of practice that I have found useful in this amputation, viz., to round off with the saw the sharp edge left on the condyle after the removal of its cartilaginous surface, and which otherwise may press injuriously upon the flap. Dr. Markoe finds that out of 40 cases in which this operation has been done, there have been 17 deaths: a rate of mortality equal to 37 per cent.

Fig. 38.

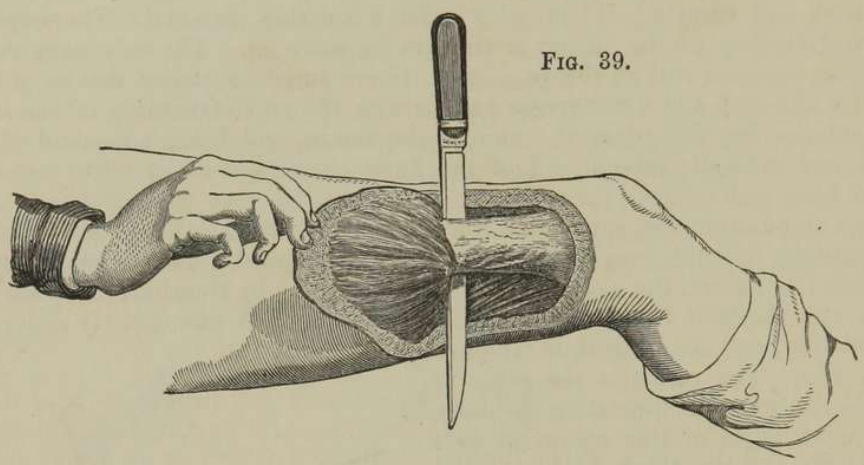


Amputations of the thigh are commonly required, both for accident and for disease; they may be performed in three situations: immediately above the knee, in the middle of the limb, or in its upper third. In the amputation in the lower and middle third, a tourniquet may be applied high on the limb: but when the operation is done in the upper third there is no space for the application of this instrument, and the surgeon must then trust to an assistant compressing the artery as it passes over the brim of the pelvis. This is best done by grasping the great trochanter with the fingers of the right hand, and then applying the thumb firmly over the artery; upon this the other thumb is then pressed as firmly as possible, and thus all chance of letting the vessel slip is prevented.

Amputation above the knee, or Vermale's operation, is best done by lateral flaps. In performing this operation, the outer flap should always be made first.

The point of the knife being entered in the middle of the thigh, about three inches above the upper border of the patella, is carried close round the bone and brought out through the centre of the ham; the flap is then cut downwards and outwards; the knife being entered again in the upper angle of the incision, is carried close round the bone to its inner side, and the inner flap made by a sweeping cut (Fig. 39). Unless the blade be kept in contact with the bone in

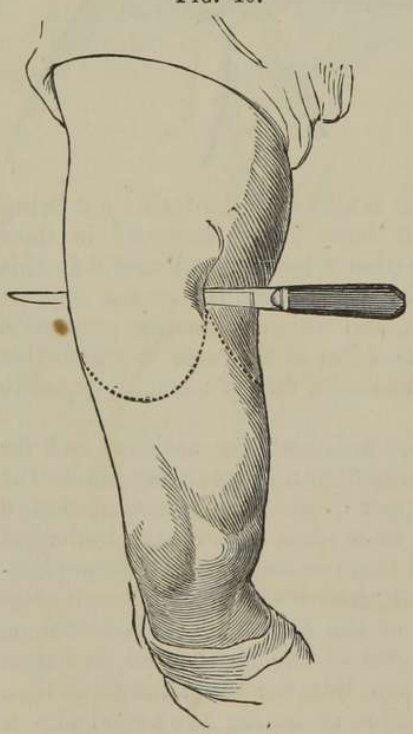
Fig. 39.



this situation the femoral artery is very apt to be split; the flaps being then retracted, the bone is cleared by two sweeps of the knife, and sawn about four inches above its articular surface.

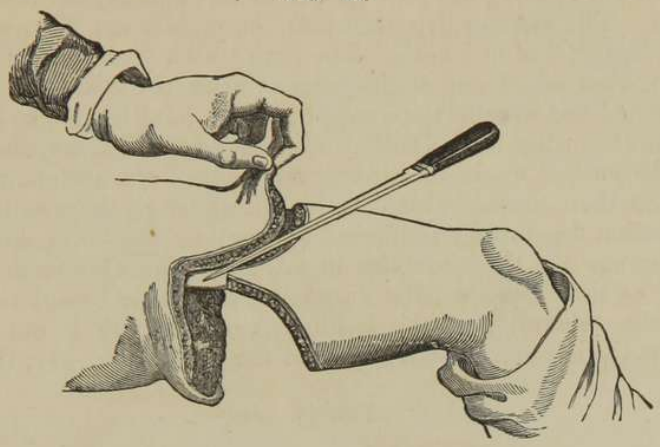
In the middle and upper third of the thigh, the antero-posterior flap operation is to be preferred. In ordinary cases the anterior flap may first be made, and the posterior one subsequently fashioned by transfixion (Fig. 40). If, however, the patient be very much emaciated, it is difficult to get a good cushion from the anterior part of the thigh in this way, and it is consequently preferable to follow the plan recommended by Mr. Luke, of making the posterior flap first by transfixion, and the anterior one afterwards by cutting from without inwards (Fig. 41). In some instances in which the tissues at the posterior part of the thigh are much diseased or injured, whilst those on the anterior aspect of the limb are sound, a very good stump may be fashioned by making a long square anterior flap by transfixion, and then cutting at one stroke of the knife through the soft part at the posterior aspect of the limb in a somewhat oblique direction from below upwards. The anterior flap when laid down will form the cushion at the end of the stump. If the patient be excessively muscular, and the amputation be a primary one, I think it is better to make skin-flaps with a circular incision through the subjacent soft parts. In this way the large gaping fleshy stumps are avoided, which commonly run into unhealthy suppuration and sloughing, and lead to the death of the patient.

Fig. 40.



Amputation through the trochanters may sometimes be advantageously practised, either in severe compound fractures of the lower part of the thigh, or in cases of those malignant cartilaginous or osseous tumors of the lower and mid-

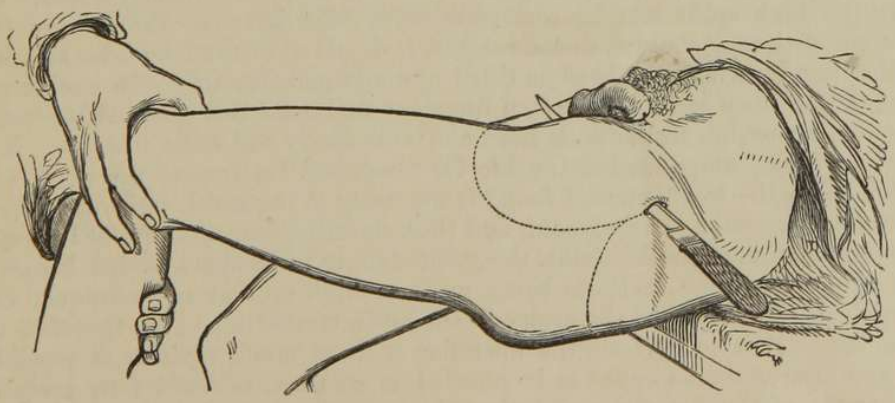
Fig. 41.



dle third of the femur, and thus the more severe and dangerous operation of disarticulation at the hip avoided. Indeed, should it be found after section of the bone that this is so much injured or diseased as to require removal at the joint, this may readily enough be done by dissecting the head out of the acetabulum with a strong scalpel or bistoury.

Amputation at the hip-joint has been performed in a variety of ways, which it is not necessary to detail. The simplest and speediest consists in making a large and thick anterior flap by transfixion, and a short posterior one from the gluteal region and back part of the thigh. In order to perform this operation properly, the patient's body must be brought well forward upon the edge of the table, so that the nates project beyond it, with the sound limb tied to the leg of the table. One assistant, whose duty it is to raise the anterior flap and compress the arteries as they are cut, should stand behind the surgeon; another must have charge of the limb and impress such movements on it, as to bring the head of the femur into the best position for the proper performance of the operation. The duties of both these assistants are of the utmost importance, and should only be entrusted to fully competent persons. The pelvis and body

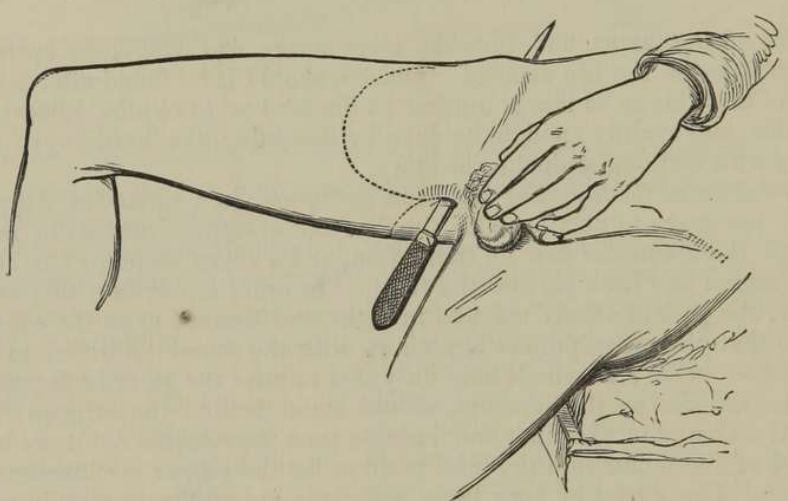
Fig. 42.



must be well steadied by two or three others. The knife, which must have a blade twelve inches long, requires to be entered and the flap to be made in different ways, according to the side of the body on which the operation is per-

formed. If it be on the left side, the knife should be entered about two fingers' breadth below the anterior superior spine of the ilium, and carried deeply in the limb behind the vessels, and directly across the joint; its point being made to issue just above the tuberosity of the ischium (Fig. 42). In transfixing, care must be taken not to carry the point of the knife too high, lest it enter the thyroid foramen. The anterior flap must then be rapidly cut downwards and forwards, about five inches in length. The limb which had, during this stage of the operation, been raised and slightly flexed upon the abdomen, must now be forcibly abducted and everted; the capsule of the joint is then to be opened by a firm cut with the point of the knife. So soon as this is done, the head of the femur must be pushed up, so that it may start out of the acetabulum; the heel of the knife is then passed behind it, the remainder of the capsule cut across, and the posterior flap rapidly fashioned by carrying the knife downwards and backwards through the thick muscles in this situation. When the amputation is performed on the right side, the anterior flap is made by entering the knife just above the tuberosity of the ischium, and bringing it out two fingers' breadth below the anterior superior spine of the ilium (Fig. 43); the remaining

Fig. 43.

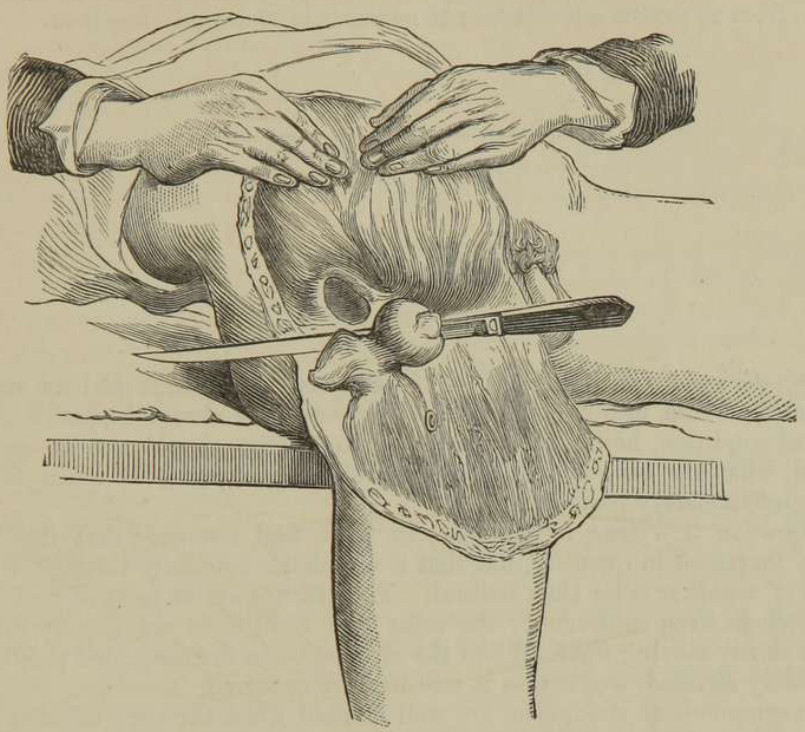


steps of the operation being performed as in the last case. In those cases in which amputation at the hip is performed for a severe compound fracture of the thigh high up, it may be somewhat more difficult to get the head of the bone out of the acetabulum, as the surgeon is deprived of the long lever afforded by the limb by which the head is tilted upwards and forwards. In such cases as these, he must seize the broken fragment and draw this down at the same time that he pushes forwards its head and cuts firmly and fairly upon it. In a case in which I amputated at the hip for compound fracture of the thigh two inches below the trochanters, I found it necessary to use much force in depressing the lower end of the fragment, and thus elevating and turning out its head.

In amputation at the hip-joint, the great danger to be apprehended is excessive hemorrhage, the incisions being made so high up that no tourniquet can be applied, or pressure of the artery in the groin trusted to. It is therefore of great importance to perform the operation with as much rapidity as possible, and the disarticulation ought to be effected in, at most, thirty or forty seconds. The arrest of the hemorrhage during the operation must be entrusted to an assistant who can be fully relied on. His business should be to compress the artery above the brim of the pelvis, and then to follow the knife in the first incision, and as the anterior flap is being made, slip his fingers under it and grasp

it firmly above and below, so as to compress the femoral artery in it, which is divided as the knife cuts its way out (Fig. 44). By grasping the flap tightly,

Fig. 44.



there will be but little risk of undue hemorrhage from the femoral artery; but lest it should slip, or the assistant whose duty it is to attend to it by any chance fail in holding it properly, it may be well to direct one of the assistants, whose business it is to steady the trunk, to have his thumb well pressed down into the iliac fossa, so as to compress the artery against the brim of the pelvis. As the posterior flap is being made, the bleeding from the gluteal and sciatic vessels, which is often very free, may be arrested by two assistants being in readiness to cover and compress them with the fingers or sponges. The arteries may then be ligatured one by one, as the assistant raises his fingers from them. If he have good hold of the femoral, the vessels in the posterior flap may be tied first; but if the femoral be insecurely held, it must first be tied. The femoral arteries, both superficial and deep, will be found to be cut long and to project from the muscles by which they are surrounded, so as very readily to be seized by the fingers or forceps, pulled out and ligatured. The arteries in the posterior flap and on the inner side of the joint will be found in the intermuscular septa. Another point of importance in this operation, in making the first puncture across the thigh, is to avoid wounding the opposite limb, the scrotum or the obturator foramen; this may be done by keeping these parts out of the way of the knife, and carefully guiding its course parallel to, but not against the pelvis.

Amputation at the hip-joint has been performed, so far as I can ascertain, in 126 cases; of these 76 died. In 47 instances it was for injury; of these 35 proved fatal. In 42 cases in which it was done for chronic disease, 24 recovered and 18 died. According to Dr. S. Smith, the mortality from this operation has been much less of late years than was formerly the case, and this is doubtless true so far as amputation at the hip-joint for disease is concerned; but in cases of injury the procedure is still a highly unsatisfactory one. In all the 12 cases

in which it was done in the Crimea it proved fatal. The diminution of late years in the mortality when this operation is practised for disease, is doubtless in a great measure due to the better selection of cases, but especially to the employment of anæsthetics, by which the severe shock to the system that usually results from so severe a mutilation is necessarily materially lessened.

CHAPTER IV.

CONGESTION.

Congestion plays an important part in surgery, it occasions serious structural changes, and runs into inflammation. Congestion is always a passive and mechanical condition, hence the term *active* congestion should not be employed. Indeed, what has been described as "active congestion" is in reality a variety of the inflammatory process.

Congestion is a true hyperæmia; in it we find not only that the blood is greatly increased in quantity, but that it circulates languidly through the part, and is of a darker color than natural. The arteries are at most of their normal size, perhaps even contracted; the veins and capillaries are greatly distended by the slowly-moving fluid. When the circulation in the congested part becomes completely arrested, *stagnation* is said to have occurred.

The *symptoms* of congestion are well marked when the part affected can be seen or felt; when occurring in an internal organ they are often very obscure. Congestion of an external part, may be recognized by the changes it induces in the color, the feel, the size, the sensibility, the temperature and the functions of the part that it affects. The color of a congested part ranges from purplish red to a dusky brown; its size is increased; it feels soft, and pits under the pressure of the finger. The patient is often conscious of a heavy, dull, aching sensation in it, scarcely amounting to pain, but yet attended with uneasiness. The temperature is never above, but often below, the natural standard, and the functions are lessened in activity.

The existence of congestion in an internal organ may be ascertained by finding its size increased, its functions modified, with a sensation of weight in it.

The *effects* of congestion are of much surgical importance. The first change that usually takes place is an effort in the vessels of the part to relieve themselves by a transudation of the more watery constituents of the blood into the surrounding cellular tissue. Hence distension of the cells of this tissue by the effused fluid, giving rise to *œdema*.

If the turgidity of the vessels be great, and their walls at the same time weakened, rupture will occur and hemorrhage on to the surface, or into the substance of the part, ensue.

In consequence of the infiltration of the cells of the part, softening takes place, nutrition becomes less and less perfectly performed, and ulceration at last occurs. These changes we not unfrequently see in the integuments of the legs of old people. In other cases the vessels becoming permanently dilated, the part assumes habitually a redder or darker tint, becomes swollen, and if it be a mucous surface, it may be roughened and papillated, as is often observed in a congested conjunctiva.

The *causes* of congestion, always mechanical, may be divided into two great classes, which we often find conjoined. 1st. Those causes that act by obstruct-

ing the return of the venous blood; 2d. Those that act by enfeebling the walls of the capillaries and veins, so that they are no longer able to withstand the outward pressure of the contained blood. Amongst the first set of causes may be specified, any condition that directly and immediately interferes with the proper return of blood through a vein; in this way the pressure of a tumor upon such a vessel produces congestion of the part from which it carries off the blood.

Venous obstruction does not always act in so direct a manner as this, for it not unfrequently happens that obstruction to the return of blood from one organ, will occasion a congestive condition of the vessels in a distant one. Thus we find that some forms of congestion of the eye-ball are due to obstruction in the branches of the portal veins.

The long-continued dependent position of a part may occasion its congestion by the blood mechanically gravitating into it, and overcoming, by the pressure thus brought to bear upon the vessels, the onward movement of the fluid within them. Thus we see congestion of the legs from long-continued standing; of the hemorrhoidal veins from an habitually sedentary life; and of the posterior part of the lungs of those who have been long confined to the recumbent position.

Amongst the most common causes of congestion that act by enfeebling the vessels, we find the debility of old age, acting partly by lessening the tone of the vascular system generally; and partly by inducing a diminution of the propulsive power of the heart. So also cold, by lessening the vitality and retarding the circulation of a part, produces congestion of it. Certain typhoid, or adynamic states of the system, favor the occurrence of congestion in the more dependent parts. And lastly, inflammation may terminate in this condition.

The obstructive causes are especially apt to induce congestion when they occur in connection with a feeble condition of the vascular system.

The *treatment* of congestion has strict reference to its cause.

The first indication consists in the removal of any source of obstruction to the return of blood from the part, as by unloosening a ligature, or elevating a part that has been too long dependent; or, less directly, as in the case of many internal congestions, by restoring the freedom of the circulation through the larger viscera. Thus, a congested eye or pile may be relieved by the removal of hepatic or portal obstructions.

The next indication consists in lessening the quantity of blood in the congested part. The mere removal of the obstructing cause may effect this. In other cases, the direct removal of the blood by scarification, as in a congested conjunctiva, or by leeches, as around a turgid pile, affords immediate relief. In some parts again, the judicious application of a bandage will prevent or remove congestion. With this view the hand and arm are bandaged before the apparatus for a fractured clavicle is applied: and in varix the leg is supported by an elastic stocking, to lessen the pressure of blood in the dilated veins.

The third indication in the treatment of congestion, consists in constringing the dilated vessels by the direct application of an astringent to them; thus we habitually apply nitrate of silver to a congested mucous membrane, and cold douches to many external forms of the disease.

DETERMINATION.

Increased vascular action lies at the bottom of most surgical processes; few important surgical actions taking place without it. No process by which the separation of dead parts is effected, or by which the repair of wounds or ulcers is carried out, can occur without an increased activity of the vessels of the parts concerned. Every tissue is susceptible of it; and the surgeon often excites it intentionally as one of the most efficient of his therapeutic means; hence an

acquaintance with the elements and the details of the process, with its nature, symptoms, causes, results, and terminations, is of the first moment.

Increased vascular action is of two distinct kinds: 1st. *Determination;* 2d. *Inflammation.* These two conditions, though in practice most commonly found more or less conjoined, require to be studied separately.

In *determination,* the blood is increased in quantity, of a bright arterial color, and circulates through the parts with great rapidity. This condition, which is often called "increased action," consequently resembles congestion in the blood being in excess, but differs from it in every other respect.

Determination of blood is a vital process, often of a very transitory character, and frequently occurs as a normal action in those conditions of the system in which, for temporary purposes, an increased afflux of blood is called for by particular organs. The enlargement of the mamma before lactation, and the turgor of the erectile tissues, afford familiar illustrations of this act. The surgeon often employs determination of blood for therapeutic purposes. Under these circumstances, therefore, it cannot be considered a disease.

When determination of blood is of a chronic or continued character it may lead to such changes in the appearance, structure, and functions of a part as materially to modify its nutritive and secretory activity, and then it becomes truly a disease. Under these circumstances the part is often said to be in a state of "chronic irritation."

The *symptoms* that characterize determination of blood to a part, are those that we should expect to result from an increased quantity of blood rushing with increased velocity through the affected textures. There is redness of a bright scarlet hue, swelling from turgescence of the vessels, heat cognizable to the surgeon as well as to the patient, a feeling of fulness and of throbbing, with an increase in the quantity of the secretions of the part; in fact, all those symptoms that characterize inflammation in its milder forms, but in a minor degree, and of a less persistent character.

The *effects* of determination of blood, when acute, consist either of rupture of the affected vessels, and a natural relief by the hemorrhage which ensues, as may happen in piles after a dose of aloes has been given; or, in the pouring forth of the secretions of the part, if a free surface or gland, considerably augmented in quantity and deviating somewhat perhaps from their normal character, as in lachrymation after the introduction of a grain of snuff into the eye. When this occurs within shut serous sacs, dropsical accumulations may ensue.

The more remote effects of chronic determination of blood to a part, consists in permanently increasing its nutritive activity and thus leading to induration and hypertrophy. Or, determination of blood may result in true inflammation.

The causes of determination of blood are three-fold:

First, An external irritant directly applied to a part will induce it, as when a grain of dust is blown upon the conjunctiva. Secondly, internal irritation, as an increased use of a part, will determine an increased flow of blood to it. Thus, using the eyes much in microscopical investigations may produce redness, watering and irritation of those organs. To this class of causes may be referred the various forms of normal determination.

The last class of causes consists in the repercussion of blood from one part to another.

The treatment of determination of blood is nearly identical with that of the milder forms of inflammation; hence we shall reserve the consideration of it until we come to treat of that disease.

INFLAMMATION.

The study of the inflammatory process is one of the most complex and difficult on which the surgeon can enter, but the labor required to master its

details is well bestowed, inasmuch as an acquaintance with its nature, symptoms, and progress, gives an insight into a great part of the science of surgery. The management of inflammation as it affects different tissues and organs, and thus constitutes distinct diseases, comprises a great part of the duties of a surgeon. The theory of inflammation is a purely physiological and pathological study, and however interesting its investigation may be, yet as the discussion of this subject belongs rather to the domain of general pathology than to that of practical surgery, it cannot consistently be entered upon here; but regarding the subject from a surgical, rather than from a physiological or pathological point of view, we must discard all hypothesis, and confine ourselves to the results of trustworthy observation.

We have seen that in congestion the quantity of blood is increased, but the rate of its motion is lessened; in determination we have everything augmented, there is an increased size of the vessels, and an increased quantity of blood within them, circulating through them with increased velocity. In inflammation we have a combination of these conditions; we have an increased size of the vessels, an increase in the quantity and rapidity of the motion of the blood, but conjoined with this we have a tendency to its arrest, to its stagnation at points. In studying the phenomena of inflammation in the web of the frog's foot under the microscope, we observe that the first change on the application of a stimulus is the momentary contraction followed by dilatation of the artery; the flow of blood through it and the capillaries is at first accelerated, retardation from congestion then ensues, and lastly, stagnation at points.

At these centres of commencing stagnation, it will be seen that the blood appears to ebb and flow, oscillating to and fro, and then stopping at last; the immediate stagnation taking place in those capillaries, which are not in the direct line of passage from an artery into a vein, and the arrest taking place by the adhesion of the red corpuscles coalescing by mutual adhesion into masses, which, after being carried bodily up and down more and more slowly, at last appear to block up the vessel, partly by overcrowding and distending it, and partly by becoming adherent to its walls; this adhesion usually commencing at the angle of union between two capillaries. Around the stagnant part the vessels are crowded by an aggregation of the red corpuscles, which appear to be more closely packed in consequence of the draining away of the liquor sanguinis. The blood does not enter the part of the vessel in which stagnation has taken place, but passes off by a collateral branch (W. Jones).

At this part also, where the circulation is retarded, the white corpuscles may be seen to be increased in quantity, and appear to be adherent to the wall of the vessel, along which they are either stationary, or at most roll but languidly. Around the whole of this area, in the centre of which there is stagnation with retardation of the blood, there is that increased rush of an increased quantity of blood, characteristic of determination.

These are the general phenomena presented by an inflamed part when studied under the microscope. In order to become acquainted with the elements of this process, we must analyze the condition of the vessels and of the blood.

First, as to the Vessels: — The arteries, capillaries, and veins are all enlarged, not only in the part inflamed, but those around and leading to it, so that more blood is conveyed with greater rapidity to the seat of disease. Is this enlargement of the inflamed vessels primary or not? This would appear to depend greatly upon the stimulant that excites the inflammation, and perhaps on other circumstances that we cannot readily appreciate; thus, if a weak solution of salt, or if ice-cold water or spirit of wine be applied to the web of a frog's foot, there is a momentary constriction of the arteries and retardation of the flow of

blood, followed by rapid dilatation and accelerated flow. In other cases again, as W. Jones has observed, the dilatation may be primary, no contraction preceding it, as happens when a strong solution of salt or of sulphate of copper and vinum opii is applied to the part. The solid sulphate of copper produces speedy, complete, and permanent contraction.

Though the vessels generally are enlarged, the arteries especially become dilated, and this dilatation implicates the afferent vessels to a considerable distance, which can be felt, by the volume of their pulsations, to be increased in bulk. That the coats of those vessels leading to the inflamed parts are dilated in consequence of being relaxed, is evident from the fact that the pulsation in them is stronger and more forcible than in other parts of the arterial system, though equally dependent upon the heart's action, to which their diminished tonicity offers less resistance. This may be readily observed in the pulsation of the digital arteries in a case of whitlow. That the vessels convey more blood *through* as well as *to* the inflamed part, is proved by the observation of Lawrence, who found that in bleeding a patient, with whitlow of one hand, in both arms, more blood flowed from the inflamed than from the sound limb, in the same space of time.

In consequence of the dilatation of the smaller arteries and capillaries of the part, red corpuscles are admitted in crowds where single files could only penetrate before; hence an appearance of new vessels is presented, though none are in reality formed. It is in this way that the surface of the conjunctiva may in a few hours be brightly reddened, not by the formation of new vessels, but by dilatation and accumulation of blood in previously existing ones.

Besides this dilatation of the smaller vessels of the part, the arteries become elongated, tortuous and waved, increasing in length as well as in diameter. The German pathologists — Kölliker, Hasse, and Bruch, whose views are confirmed by Paget and W. Jones—have observed that the arteries of the inflamed part have a tendency to become dilated at points, so as to present small varicose, or aneurismal pouches projecting from their walls, or fusiform dilatations of their whole diameter. These changes would appear to arise from one of two causes; either that the vessel is constricted at points between which it maintains its normal width, and thus that the dilatation is apparent and not real; or, that it is actually dilated where it appears to be so.

I shall not enter upon the question as to the causes of these changes in the vessels; how a stimulant acts in giving rise to them, and what share the nerves of the part may have in their production; as these are points out of the scope of this work, and which, indeed, appear as yet to be altogether undecided.

The changes that the blood undergoes in inflammation are fully of as great importance as those presented by the vessels.

The most apparent physical change met with in this fluid, is, that it appears to have become thinner, as was long ago pointed out by Hewson. But there are other changes that can only be appreciated by chemical and microscopical research. These we must study as they affect the different constituents of the blood.

The red particles have been shown by Andral and Gavarret to be increased in quantity in the early stages of inflammation, but as the disease continues, they speedily diminish in number; falling below the natural standard in this respect, as W. Jones and Simon have pointed out. No other apparent change takes place in these particles, except the tendency to their aggregation into clusters by the cohesion of their flat surfaces. This clustering of the red particles, first pointed out by W. Jones, takes place in the vessels as well as out of them, and is considered by its discoverer, and by Henle, to be owing to inspissation of the plasma.

The white corpuscles have excited much attention of late years in connection with the arrest of circulation in inflammation. Dr. Williams has shown that

they appear in increased numbers in the inflamed part, and by their adhesion to the walls of the vessels, become one principal source of the arrest of the circulation. There are several questions, however, with reference to the white corpuscles. 1stly. As to their actual increase; 2dly. As to the cause of this increase in their numbers; and 3dly. As to their greater disposition to adhere to the vessels. Their increase in inflammation is stated by W. Jones to be partly relative, owing to the diminution in the red particles; and Paget, as well as other observers, is of opinion that it is only in sickly and young animals, kept for the purpose of experiment, that this increase has been observed, never being met with in healthy animals, or in the human blood taken from inflamed parts. Hence he infers that they are only met with in large numbers in inflammation, when existing numerously elsewhere. Their appearance in large numbers in the vessels of the inflamed part, and their accumulation here, is ascribed by W. Jones simply to retardation of the circulation; this condition being consequently the effect, and not the cause of the obstruction which, however, they may mechanically increase when it has been once induced.

The natural adhesiveness of the white corpuscles to the sides of the vessel is such as to require a brisk current to sweep them along, hence when the force of this is lessened, as is the case in an inflamed part, they are not readily detached; but, as it has been shown that the tendency to cohesion is increased in the red corpuscles, it is but reasonable to believe, with Dr. Williams, that the adhesiveness of the white ones may also be augmented.

The liquor sanguinis undergoes important changes in inflammatory blood. Quesnay, Hey, Thackrah, Babington, and Grainger, have all observed that the quantity of fibrine in it increases, and Andral and Gavarret have shown that it may rise from 2½ per 1000 as high as 10 per 1000. This superfibrination of the blood probably results from waste or oxidation of the tissues, and its augmentation must not be looked upon as an increased development of nutritive power. It is in fact the consequence of changes taking place in the blood and parenchyma of the diseased part.

The proportion of albumen and of saline matter is somewhat below the natural standard, whilst that of the water is increased above it.

When inflammatory blood is drawn from the body it coagulates more slowly than healthy blood; the coagulum also is harder and smaller, and the quantity of serum apparently greater. The surface of the coagulum is commonly covered by a tough layer of yellow fibrinous matter, the *buffy coat;* and its upper surface is depressed in the centre, having elevated edges, being *cupped*, as it is usually termed. By this "buff" and "cup" the practitioner commonly estimates the intensity of the inflammation; but it must be borne in mind that buff may occur in certain conditions of the system, as in plethora, pregnancy, or after exercise, without the occurrence of inflammation; and that the tissue affected, rather than the severity of the inflammation, influences its quantity: thus, it is greatest if the fibrous or serous tissues, and least when the mucous or tegumentary, are inflamed. The cupped shape of the clot may likewise be owing, in some degree, to the kind of vessel in which the blood is received, being most evident in those which are rather narrow and deep.

These are the principal changes met with in the vessels and blood of the affected part, but it must not be supposed that the inflammatory process consists simply in these changes; the nerves and parenchyma doubtless exercise an important influence, the precise nature and extent of which can scarcely at present be appreciated, though the observations of Paget and W. Jones demonstrate its existence.

SYMPTOMS OF INFLAMMATION.

The *symptoms* of inflammation are *local* and *constitutional*. In order that these should occur, so as to establish the existence of the inflammatory process,

it is necessary that those actions that constitute it continue for some length of time; as they gradually pass from determination and congestion into inflammation, it is difficult to say, except by the persistence and intensity of the symptoms, that the physiological state has ended, and the pathological one commenced.

The local signs of inflammation may be referred to five heads; viz., *alteration in color; alteration in size; modification of sensation; increase of temperature*, and *modification of function of the part affected*. Each of these conditions may separately occur, or two or more be associated together without the existence of inflammation. But it is the peculiar grouping together of them all that characterizes the presence of this pathological condition.

The relative intensity of these changes varies greatly, according to the tissue that is the seat of the inflammation; thus, in inflammation of mucous membranes and of the skin, the alteration in color is most marked; in inflammation of the cellular tissue, the change in size always attracts special attention, and when a fibrous tissue is inflamed, its sensibility becomes greatly increased.

Alteration in color is an invariable, and one of the earliest and most striking local signs of inflammation; parts that are naturally perfectly pale, as the ocular conjunctiva, assuming the most vivid crimson color when inflamed. Some parts, though they change in color, do not become red. Thus, the iris, when inflamed, assumes a greyish or brownish tinge, and the mucous membrane of the bladder, and of a portion of intestine, often becomes slate-colored. The redness of inflammation varies from a bright crimson to a dull purple, the tint depending greatly upon the state of the constitution, and upon the presence of more or less congestion. The duller and darker the tint, the more local congestion or constitutional depression do we usually find. The redness is evidently due to the increased quantity of blood in the inflamed structure; and in the earlier stages of the disease, it is owing to the increase of the size of the vessels, the admission of new red corpuscles by which they are distended, and by the draining away of the plasma. In some low or asthenic forms of the disease, the coloring matter of the blood appears to undergo changes that allow its ready transudation through the walls of the vessels; and in more chronic cases the vascularization of the products of inflammation tends to render it more permanent.

Alteration in Size.—Dilatation of the vessels being an essential element of the inflammatory process, swelling must be an invariable accompaniment of this disease. In the early stages this is due to the dilatation of the vessels; in the more advanced conditions, chiefly to the occurrence of effusions of various kinds.

The swelling varies greatly in different localities. It is greatest in those which are of a loose texture, and least in those which are firm and dense. Thus, for instance, in inflammation of the cellular tissue of the scrotum, the swelling is much greater than in the same disease affecting the testes. The inflammation of the conjunctiva occasions great swelling, that of the sclerotic but little.

The swelling of chronic inflammation may terminate in permanent hypertrophy, or thickening of the affected parts, partly in consequence of persistent dilatation of the vascular system of the part, but chiefly from the deposition of plastic matters in the substance of its tissues.

Modification of the sensibility of the Part, owing partly to increased sensibility of the nerves, but chiefly to the pressure exercised on their terminal branches by the dilated blood-vessels, manifests itself by the occurrence of pain, or by some alteration in the special nervous sensibility of an organ: thus, in the eye, by the patient perceiving flashes of light, and in the ear, by noises of various kinds; in the bladder, by a constant desire to expel the urine, and in inflammation of the kidney, by a desire to urinate.

Pain is one of the most prominent symptoms of inflammation, and its exist-

ence serves a useful purpose by preventing the patient using or moving the inflamed part. The intensity of the pain depends more upon the structure affected than on the violence of the inflammation. As a general rule, it may be observed that the intensity of the pain is in the inverse ratio of the swelling of the part affected. Thus, the pain of inflamed bone or fibrous tissue is excessive; that of cellular membrane trifling. In erysipelas of the scalp, most pain is experienced in the ears; the pain of the inflamed sclerotic is far greater than that of a conjunctiva similarly affected.

In some forms of inflammation pain can scarcely be said to exist, though the disease may assume the most destructive form. Thus, in certain inflammatory affections of the throat and of the peritoneum there is little or no pain. Inflammatory pain is always increased on pressure. The character of pain varies according to the seat of the inflammation. Thus, when mucous membranes suffer, it is often of a gritty, itching, or burning character, as in conjunctivitis; when the serous membranes of the chest or abdomen are attacked, it is of a lancinating or stabbing character; aching in bones; throbbing when pus is about to form; sickening when the testis is affected. When the pain is principally elicited by pressure, the part is said to be *tender*. This tenderness is of great service in a diagnostic point of view; it may be elicited by direct pressure upon the part, as by squeezing an inflamed testis, or by pressing two surfaces together, as in an inflamed joint. In inflammatory pain, especially of osseous and fibrous tissues, there is very commonly nocturnal exacerbation.

It is important to bear in mind that inflammatory pain is often not seated merely in the part affected, but radiates extensively along the course of the nerves, the terminal branches of which are implicated to a limited extent perhaps. Thus, in inflammation of the testis we have pain in the loins and groins. In deep-seated ophthalmia there may be exquisite pain along the branches of the Fifth Nerve over the whole side of the head or face, in consequence of the ciliary branches of the nasal, which are distributed to the iris and choroid, becoming compressed or stretched.

The *temperature* of an inflamed part usually rises above its normal standard Hunter has, however, remarked that it does not increase above that of the left ventricle: thus, in a case of hydrocele, he found the tunica vaginalis at 92° Fahr. before inflammation had been excited in it, and at 98¾° after it had been set up. In a case of extravasation of urine, with severe inflammation, I found the temperature in the incision made in the perineum 98° Fahr. It is probable that there is always a local increase of heat in inflammation. This, however, appears to the sensations of the patient to be far greater than it is in reality. Travers truly remarks, "that the nerves measure the sensation, and not the degree of heat." In many cases the sensation to the patient is that of *burning* in the part, though the actual rise in temperature may be but trifling. This is owing to the exalted sensibility of the nerves.

The cause of the increase of temperature is interesting. In all processes in the economy in which determination of blood takes place, as in blushing or parturition, the temperature rises. This can clearly not be owing to any production of heat during respiration, which may account for the *general* heat of the blood, but not for its *local* increase. It is more probable that, as the ordinary and general supply is derived from the waste of the tissues, so that of inflammation may be due to increased destruction of organic matters in the part inflamed.

Modification of Function, Use, or Nutrition, invariably occurs in inflammation, and furnishes important local symptoms. The functional activity of an organ is increased in the earlier stages at least of inflammation, and the character of the secretions from the part materially modified. Thus, when the mucous membrane of the urethra is inflamed, there is copious discharge from it, and this is not mucous, but purulent.

The *use* of the part affected is greatly interfered with; thus, the bladder can contain no urine, the eye cannot bear the light, nor a joint be moved when inflamed.

The *nutrition* of the inflamed tissues is modified or arrested; hence, wasting, softening, or contraction, are common accompaniments of this process.

Constitutional Symptoms. — The severity of the constitutional symptoms depends on the intensity and the extent of the disease, or on the vital importance of the part affected by it; on the amount of local irritation, and whether it is owing to external or internal causes. Thus, a moderate degree of inflammation in a part of no vital importance, as the skin, and occasioned by an external cause, as an abrasion, gives rise to no appreciable constitutional disturbance. But if the inflammation be wide spread, as that of diffused erysipelas, or if it arise from constitutional causes, or if there be much local tension, as in whitlow, or if the part affected be of great importance, as the larynx or the eye, then the general symptoms become proportionally severe.

The constitutional disturbance in inflammation always assumes the form of fever — *inflammatory* or *symptomatic fever*, or *Pyrexia*. It is invariably secondary, being consecutive to the local affection. It is the true *surgical* fever, no febrile disturbance occurring in surgical practice except as a consequence of local disease or injury. This fever appears to result primarily from deterioration of the blood by the local inflammation, and from consequent reaction on the circulatory and nervous systems. Andral states that increase of the fibrine of the blood in inflammation is simultaneous with the accession of the fever, and that when once this increase of fibrine has taken place, the spread and intensity of the inflammation is increased by it. He has further observed that, in inflammation without fever, there is no increase of fibrine, and that when the fever ceases the proportion of fibrine falls to its normal standard. Thus, the local inflammation occasions the superfibrination of the blood, and this the general fever.

Inflammatory fever, or pyrexia, presents, however, an infinite variety of forms; the type which it assumes being finally dependent: 1st, on the state of the the blood; 2d, on the condition of the nervous system; and, 3d, on the occurrence of certain local or specific symptoms, dependent on the seat of the inflammation. These varieties in the type of the fever arrange themselves practically into three classes. 1. *Sthenic*, or typical inflammatory fever. 2. *Asthenic*, or typhoid fever. 3. *Irritative*, or nervous fever. In all these forms of fever, there are three distinct stages: that of invasion, exacerbation, and decline.

The *sthenic* form of inflammatory fever, true pyrexia, occurs in individuals of healthy constitution, young, or middle-aged, in connexion with those forms of inflammation that are of an active, acute character, and not unfrequently consequent upon injury.

In this form of fever, the stage of invasion is very slightly marked, though it always occurs. There are rigors, with some slight depression of the nervous system; but these symptoms may be so transient as to escape observation entirely, and speedily terminate in the stage of febrile reaction. In the majority of cases, it is not until the constitutional disturbance has reached this stage that it attracts attention. The skin is now hot, and usually dry; the pulse full, bounding, or thrilling, and quickened by thirty or forty beats in the minute above its normal rate; its character depending greatly on the tissue or organ affected. If this be the mucous membrane, skin, or a glandular structure, as the testis or mamma, it is compressible, though full; if a serous membrane be inflamed, it is small, incompressible, and wiry; if a fibrous tissue be the seat of disease, it is hard and full. The secretions are arrested or diminished in quantity; hence the urine is high-colored and acid, the bowels confined, the

tongue coated with a white fur, and the mouth clammy, usually with much thirst; there is a feeling of great languor, and the head is often heavy and hot.

As the fever declines, if a favorable termination occur, the system not uncommonly relieves itself by a critical evacuation;—from the skin, by abundant acid perspiration;—from the kidneys, by the free deposition of lithates in the urine;—from the bowels, by diarrhœa;—and from some of the mucous surfaces, by hemorrhage. The tongue cleans, the pulse subsides in frequency and strength, the secretions become freer, the thirst lessens, and strength and appetite return. Should the fever not take a favorable course, death may ensue by the occurrence of serious visceral complications; the lungs and brain being especially apt to suffer, becoming the seats of fatal inflammatory mischief; or the sthenic form of the disease may gradually merge into those types that are characterized by debility and irritation.

The *asthenic* form of inflammatory fever principally occurs in those individuals whose constitutions are broken by privation, dissipation, or by any of the general depressing causes of disease, as grief, anxiety, or long residence in a vitiated atmosphere.

In constitutions such as these, so frequently met with in all classes, but especially amongst the poorer residents in large towns, inflammatory fever almost invariably assumes a low form. There is also, in this variety of the disease, a special tendency to its complication with visceral mischief; the lungs being peculiarly apt to become affected by a low form of pneumonia.

The asthenic form of the disease may come on as a sequence of the sthenic variety that has just been described; the symptoms gradually merging into those of a low form, and being characterized by debility rather than by strength of action, the pulse becoming weaker though its frequency is kept up, the tongue becoming brown and dry, with a tendency to the early supervention of delirium of a muttering kind.

When the fever assumes the asthenic form from the very first, the period of depression is strongly marked, and often prolonged for many hours, reaction coming on gradually and imperfectly, alternating with the depression against which the system is struggling. Even when fully established, the symptoms of this stage of reaction are not of a very active character; there is throughout an appearance of heaviness or stupor about the patient, with little activity of the intellectual faculties, and an early tendency to delirium of a low form, especially at night: the pulse is feeble, though quick; the skin either moderately hot, or else pungent and burning; the tongue brown and dry, with sordes rapidly accumulating about the lips and teeth; the cheeks are often flushed, and the eyes bright and staring. As the third stage comes on, if the patient recover, critical evacuations, often of a hemorrhagic or diarrhœal character, come on: the pulse subsides, the tongue gradually and slowly cleans from the sides and tip, and the patient slowly and imperfectly regains his strength; the convalescence being often interrupted by intercurrent disease, and the powers of the constitution being frequently broken for months, or for life. If the disease take an unfavorable course, the weakness of pulse, and dark incrustation of tongue increase; the skin becomes cold; hiccup, subsultus, dyspnœa, or coma, supervene; and death occurs from exhaustion, or as the result of visceral complication.

The *irritative* fever is of a less specific type. It is usually associated with the asthenic form, the nervous system being especially implicated. It occurs in individuals whose mental powers have been overwrought, or whose nervous systems have been irritated and shattered by intemperance. It is characterized by irregularity in its actions, sudden exacerbations, and a rapid decline. The several febrile symptoms run high in the early stages. The pulse soon becomes sharp and small; there is high delirium of a furious kind, wildness of eye, and

heat of head. But these symptoms soon give way to signs of debility and exhaustion, and death takes place from coma and cerebral irritation.

TERMINATIONS AND EFFECTS OF INFLAMMATION.

There are two ways in which inflammation may terminate without leaving any traces of its presence in the part affected; these are by *Resolution*, and by *Metastasis*.

The termination by *resolution* simply means a return to health. The pain and heat first subside, the swelling lessens, and lastly the redness passes away: the constitutional symptoms also disappear. With regard to the more intimate changes in the part itself, it will be seen that the dilated vessels contract, the stagnant masses of blood-discs are pushed on and broken up by streams finding their way into and against them. Absorption, which had been held in check during the continuance of inflammation, comes into play and removes the extravasated matters, and secretion becomes more active, and helps to unload the part. Resolution may in this way be complete, or it may go on to a certain point and then stop, leaving one or other of the effects that will immediately be mentioned.

By *metastasis* is meant a change in the seat of the inflammation, its sudden and complete disappearance in one part and reappearance in another. This is of extremely rare occurrence; it is occasionally seen however, as in the inflammation of the testis, that suddenly supervenes on the disappearance of a gonorrheal discharge.

Besides these true terminations, inflammation commonly passes from the ordinary and primary condition into some other form of the disease. Thus, for instance, when plastic matter or lymph is thrown out, *adhesive* inflammation is said to have occurred. When it terminates in the production of pus, we have *suppurative* inflammation. When an ulcer forms, *ulcerative* inflammation is said to have set in, and when the inflammatory action is of such intensity as to cause the death of the part affected, *gangrenous* inflammation has occurred. These different conditions of the inflammatory process differ so widely from its ordinary forms, and from each other, as to constitute distinct diseases, and as such to require separate and distinct consideration.

When inflammation has once been set up in a part it may extend to other portions of the system in four distinct ways. 1st. By local extension; this may occur by the inflammation spreading along the tissue affected in its *continuity;* as, for instance, along the skin, cellular or mucous membranes.

2d. It may also spread by *contiguity* of tissue, passing from one affected structure to an adjacent healthy one; thus we see the opposite surfaces of an inflamed joint involved in disease at opposing points.

3d. Inflammation may extend to distant parts through the medium of the blood. This fluid being altered and depraved, and increasing the liability to inflammation in other parts, as in some of the erratic forms of erysipelas; or, conveying pus to a distance, as in phlebitis, and thus giving rise to numerous centres of inflammation.

4th. Inflammation may be carried to a distant part by metastasis, as has already been stated.

Effects of Inflammation. — Closely allied to the local symptoms of inflammation, are the local *effects* of this disease. These consist first, of changes in the consistence of the part inflamed, which may be of two kinds. *Induration*, chiefly as a consequence of chronic inflammation, occasioned by the turgescent state of the vessels of the part, or the effusion of plastic matter within it. *Softening*, chiefly after acute inflammation, depending partly on the infiltration of effused liquids into the textures, and partly on a disintegration of the substance, and thus a lessening of the consistence even of the hardest tissues, by

impairment of their nutrition: thus an inflamed bone may be cut and pared down with a knife, or the ligaments of an inflamed joint become so soft as to admit of spontaneous dislocation. This softening may ultimately lead to the interstitial absorption of a part, which becomes shrunken and contracted after inflammation. Ulceration, as will hereafter be fully stated, is not an unfrequent consequence of this softening and atrophy conjoined with rigidity, as we see in these joints that have undergone inflammation.

In chronic inflammation we not unfrequently find that increased nutritive activity of the part leads to an increase in its size and growth, partly owing to actual augmentation in bulk of the tissues of the part; in many cases, however, being rather dependent on effusions into the cellular membrane. Instertitial absorption and gradual wasting of a part without previous softening, often occur as an effect of inflammation. Thus, a blow on the hip will occasion absorption and shortening of the neck of the femur.

Loss of transparency in structures that are normally translucent is a common effect of chronic inflammation, as may every day be observed in the cornea or in the capsule of the crystalline lens; in some cases this rather depends upon a modification of nutrition than upon the deposit of new matter upon the part. In other cases, again, it proceeds from the deposition of plastic matter in or upon it.

The symptoms, terminations, and effects of inflammation that have just been described, are those which characterize the more ordinary forms of the disease. In practice, however, we recognize many important varieties of this affection. These may be referred to three heads, as they affect its *duration*, its *intensity*, or its *character*.

1st. As to duration. The disease may be acute or chronic, varying from a few days to many years, being especially persistent in those structures that are naturally least vascular, as, for instance, bones and joints.

2d. As to intensity. When the symptoms are well marked, the redness and heat great, the tension considerable, and perhaps the pain severe, with corresponding constitutional disturbance, the inflammation is said to be *active* or *acute;* when of a less intense character, it is termed *sub-acute;* and when there is merely redness and swelling, with little or no pain, and but slight constitutional disturbance, the disease is said to be of a *passive* kind. The duration of the inflammation commonly influences its intensity, which is usually less in the more chronic cases; but very frequently we find the reverse, and that when of but short duration it may be sub-acute or passive, whereas some forms of a very chronic character may retain great activity, and are especially liable to recurrent active attacks.

3d. As to character. If the inflammation is circumscribed, occurring in a healthy constitution, and tending after a moderate time to terminate in resolution, it is called *healthy* or *phlegmonous*. If the vessels become distended and dilated, the blood slowly circulating, the redness of a purplish tinge, and the swelling considerable, with but little heat, the disease is said to be *congestive* Of *unhealthy* inflammation there are numerous varieties; the *diffuse* having a tendency to spread widely unchecked; the *strumous* being modified by scrofula; and the *specific* inflammations, that arise from special causes, and are frequently capable of self-propagation.

THE CAUSES OF INFLAMMATION.

The causes of inflammation may be divided like those of all other diseases, into *predisposing* and *exciting*, and these again may either be of a strictly local character, or act locally, through the medium of the constitution.

Local predisposing causes. — Though every tissue of the body is susceptible to inflammation, yet some parts are more liable to it than others. This cannot

be owing to any greater degree of vascularity, for we find that the tissues lining the interior of a joint more readily and more violently inflame, though they are almost extra-vascular, than a portion of the mucous membrane which is so abundantly supplied with vessels. Indeed, serous and synovial membranes are more liable than most other tissues to inflammatory excitement. Whatever the reason of this may be, there are two sets of causes that more especially predispose tissues to inflammation.

Thus, habitual over-use or over-stimulation of a part, by producing determination of blood to it, may readily drive it into inflammation.

When a part having once been the seat of inflammation, has been left in a weakened or impaired state, it will be more liable to the occurrence of a second attack of inflammation, having less resisting power; hence, also, subsequent attacks are induced by less active exciting causes than were required to call the first disease into action; we see this in the inflammatory affections of eyes and joints. Then, again, a tendency to local congestion or stasis will dispose to inflammation, very slight over stimulation inducing the disease when the vessels of the part are already overloaded; this is often seen in the case of varicose veins, the congested skin readily running into inflammation.

It is of great consequence to ascertain whether any constitutional predisposition to inflammation exists, and if so, what its precise nature is, for the progress of the local affection will in a great measure be dependent on the amount of constitutional predisposition. The constitutional predisposing causes are of two kinds.

1st. Inflammation is predisposed to by a state of general over-stimulation of the vascular and nervous systems. This condition may be hereditary, as in the sanguine temperament, or dependent on youth and sex; or it may be acquired by habitual indulgence at table; the induction of plethora, producing an inflammatory habit of body. And inflammations occurring in this habit of body are usually of the sthenic variety, though not unfrequently accompanied in the case of those accustomed to alcoholic stimulants, by fever of an irritative form.

A directly opposite condition of the system equally disposes the person to inflammatory attacks. Thus a state of vascular and nervous depression, by lessening the reacting power of the constitution, causing a loss of tone in the vascular system, with ready tendency to dilatation of the vessels, and to stagnation of blood, disposes to inflammation. In this way inflammatory actions are especially apt to occur in scrofulous patients, in whom the general powers are enfeebled, and in such individuals they occur under the influence of minor exciting causes than in those in whom nutrition is more actively carried on. Here inflammation usually assumes the passive, congestive, or asthenic forms.

The exciting causes of inflammation are very numerous and simple in their action. Commonly, mechanical injuries are those that occasion surgical inflammations, which are, indeed, set up by nature as the means of repairing the effects of the injury.

Chemical agencies, as the application of caustics, and undue extremes of heat and cold, are also amongst the most common exciting causes. The application of the virus of certain morbid poisons, as of syphilis and the malignant pustules, directly occasion it. And lastly, certain states of the blood give rise to it, as we observe in those conditions of the system in which boils, carbuncles, &c. are produced.

TREATMENT OF INFLAMMATION.

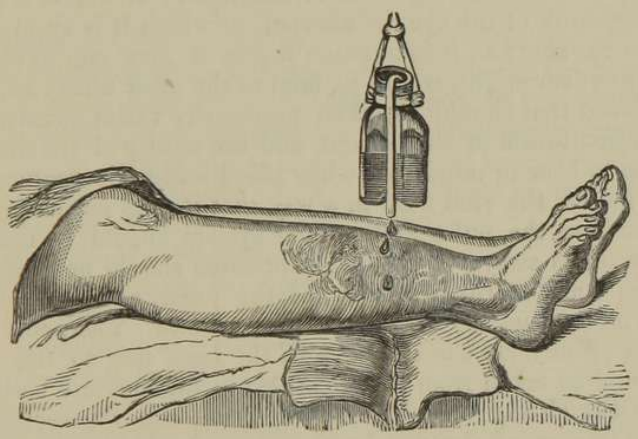
The Treatment of Inflammation may be divided into the preventive and the curative.

The *preventive* treatment can only be employed in inflammations supervening on injury. In it the principal point to be attended to is, the removal of the local and constitutional causes of irritation. By doing this, the occurrence of

inflammation in a part that has been injured, or otherwise disposed to its accession, may be entirely prevented, or, if this be not accomplished, much lessened in severity.

The *local preventive* treatment of inflammation is best carried out by the removal of all sources of irritation, by absolute rest of the part, and by the free application of cold. If the injury be superficial, and not very severe, lint dipped in cold water, frequently renewed, may be applied; or, if the skin be unbroken, an evaporating lotion may be used. Should a limb or joint be severely injured, the cold irrigation will be a preferable mode of reducing its temperature. This may most conveniently be done by suspending over the part a large wide-mouthed bottle, full of water, in which a few pieces of ice may, if necessary, be put; one end of a skein of cotton, well wetted, is then allowed to hang in the water, whilst the other is brought over the side of the bottle. This, acting as a syphon, causes a continual dropping upon the part to which the cold is to be applied. (Fig. 45.) In some cases the application of pounded ice in a bladder or of cold evaporating lotions, may be preferred to the irrigation.

Fig. 45.



At the same time all constitutional irritation must be removed by abstinence, rest, and a free aperient.

In undertaking the *curative treatment* of inflammation, the surgeon must not allow himself to be guided by the name of the affection that he has to do with, but he must be influenced in the means that he adopts by the actual condition of the patient, and the state of the diseased part; for nothing presents greater variety than the management of the inflammatory process, in different conditions of the patient, and in the different phases of that affection. We shall accordingly consider the treatment of inflammation as applied to the acute and sthenic, the chronic, and the asthenic varieties of the disease.

Treatment of acute Inflammation with fever of the Sthenic type. — In the treatment of this variety of the disease, active and energetic measures must early be had recourse to, especially if the patient be young and strong. There is no affection that is more under the control of the surgeon than this when occurring in a healthy constitution, and in which more can be done by active means early employed. It is consequently of the first importance that precious time be not lost by the employment of inefficient measures, otherwise important local changes and irremovable alterations of structure may ensue. It is also of great consequence to remove the disease fully; not only to subdue it, but to extirpate it, lest it degenerate into some of the more chronic, passive, and intractable forms.

The first thing to be attended to in the treatment of the sthenic, and of all the other varieties of inflammation, is the removal of the cause. Thus, rest

must be afforded to a diseased joint, light removed from an inflamed eye, and a foreign body taken out of the flesh in which it is lodged.

The next great indication is to lessen the determination of blood to the part. The measures for accomplishing this comprise what is termed the *antiphlogistic* treatment. This consists of constitutional and local means.

Constitutional antiphlogistics. — The most powerful and efficient that we possess is certainly blood-letting, and when the inflammation is sufficiently extensive and severe, and the patient's powers warrant it, we may have recourse to the abstraction of blood. Now, blood can easily be taken away, but it cannot readily be restored to a patient, and we should never remove it unnecessarily, lest permanent ill effects to the health ensue. It is certainly not often required in the treatment of surgical inflammations; and should be especially avoided in very young and very old subjects; in the inhabitants of large towns generally; or in those in whom inflammation of a specific character occurs: hence in hospital or private practice it is now often found advisable to have recourse to other means in its stead. It should never be had recourse to unless an organ of great importance to the economy, as the lung or brain, for instance, be inflamed, or so injured that inflammation of it is imminent; or unless a tissue, like the transparent structure of the eye, be affected, in which it is absolutely necessary, at any risk, to cut short an inflammation before it give rise to change of structure, which, however slight, would be fatal to the after utility of the part. The quantity of blood that should be taken necessarily varies greatly, according to the age and constitution of the patient, and the nature of his disease; and it is of importance to bear in mind that when blood-letting is required, the system tolerates the loss of the vital fluid in a way that it does not otherwise do. The effect produced on the pulse and on the system should be the guide to the quantity to be taken away. A decided impression should be produced by blood-letting, not so much on the frequency of the pulse, as on its character; *that* should guide us, and not the number of ounces drawn. The point to be obtained is the greatest effect upon the system with the least loss to the patient, hence the blood should be taken from a large orifice in the medium basilic, or cephalic vein, the patient sitting upright. In repeating the venesection we must be guided by the impression that has been made upon the disease and by the state of the pulse. Purgatives should always be given early, except in some special cases of acute inflammation of the abdominal organs. They clear the intestinal canal, free the secretions, and equalize the circulation. In general, it will be found most advantageous to administer a mercurial, followed by a brisk saline purge, and this should be repeated from time to time during the progress of the case.

Diuretics and diaphoretics require to be administered frequently during the day. If the skin is hot and dry, antimonials should be given in small and repeated doses; these may advantageously be conjoined with, or replaced by, salines, such as the citrate of potass, the acetate of ammonia, or nitre. In this way the force of the heart's action is lessened, and the skin and kidneys are called into active operation. It is also probable that the salines alter the constitution of the blood, dissolving the fibrine and lessening the quantity of water, both of which constituents are in excess in inflammation.

In many forms of sthenic inflammation, especially in those which affect the serous and fibrous membranes, we do not possess a more efficient agent than mercury administered, not as a purgative, but as an alterative to the system. *Mercurial remedies* are of special service in aiding the operation of other medicines. Diuretics, diaphoretics, and purgatives will frequently not act properly unless conjoined with a mercurial. In inflammation the preparations of mercury act as direct antiphlogistic agents, lessening the quantity of fibrine in the blood, and equalizing the circulation. They are of especial value in promoting the absorption of exudation matters, more especially of lymph, as

we may see happening under their influence in certain diseases of the eye. They appear to do this rather by lowering the vascular action of the part, and thus allowing the absorption to be carried on, which had been arrested during the persistence of the inflammation, than by any specific influence exercised over the effused fibrine. Care, however, is required in the administration of this mineral. In irritable or cachetic constitutions it should not be given at all, or not without great caution. It is best borne by strong constitutions, and in acute inflammation of the serous and fibrous tissues.

Calomel, blue pill, and mercury and chalk, are the preparations usually employed when the mineral is given by the mouth. When administered endermically, the mercurial ointment is preferred; and the use of the mineral is in general continued until the gums become spongy, and a red line is formed at their edge; the patient experiencing a coppery taste in the mouth, and the breath becoming fetid. It is not necessary to induce profuse salivation.

It is especially the combination of calomel with opium that produces the most beneficial effects in the treatment of surgical inflammation. Two grains of calomel, and a third or half a grain of opium, every fourth or sixth hour, tranquillize the system and lessen vascular action in a remarkable manner.

Opium is not only of use in the way that has just been indicated, but is of essential service in allaying the pain and irritability that often accompany inflammation, especially in many inflammatory affections of the bones and joints. In the form of Dover's powder it is of especial value in this respect.

In the treatment of active inflammation, it is of essential consequence that the patient should be kept at rest in a well regulated temperature on low diet; in fact, the more complete the abstinence in this respect is, the more rapidly do therapeutic means act and the febrile symptoms cease.

The *local* treatment of inflammation is of the utmost importance, as it directly influences the vessels that are deranged in action. It consists of means of the most varied and opposite character; heat and cold; iced water and poppy fomentations; astringents and sedatives, are all employed, and all with success, but each only in certain stages and forms of the disease; and the art in conducting the local treatment of inflammation consists in adapting the various means at our disposal to the particular condition of the case before us.

Local bloodletting is the most efficient means we possess in directly lessening vascular action in a part, as by it we take the blood directly from the inflamed and turgid vessels. It may be used in addition to, though it is now very commonly employed in preference to, general bloodletting; especially if the inflammation be not severe, if it occur at either of the extremes of life, in women, and in persons generally of feeble power.

Blood may be taken locally by punctures, scarifications, incisions, or by leeching or cupping.

Punctures and incisions can only be practised in inflammation of the cutaneous and exposed mucous surfaces, due attention being had to subjacent parts of importance. They constitute a very efficient means of relief to the part; as not only is blood removed, but an exit is afforded for effused matters; tension and pain are consequently materially lessened, and the tendency to sloughing and other after-consequences perhaps prevented. The punctures should be made with a fine lancet, in parallel rows over the inflamed surface, and should not exceed a quarter of an inch in depth. The incisions must always be made in the axis of the limb, and should be so arranged as to afford the greatest possible relief to the tension of the parts. Their extent superficially and in depth must vary according to the seat of the inflammation. Thus, in the inflamed conjunctiva they must of course be very limited in this respect, whilst in phlegmonous inflammation of a limb they may be of much greater extent. Care, however, must always be taken not to wound superficial arteries or veins. A modification of puncture is sometimes practised by opening the veins in the

neighborhood of the inflamed part at several points at once. Thus, in inflammation of the testis the scrotal veins may advantageously be punctured. The bleeding from punctures and incisions should always be encouraged by warm fomentations.

Leeches are usefully applied to the neighborhood of inflamed parts, but should not be put upon the inflamed surface itself, as their bites irritate. There are certain situations in which leeches should not be placed, as over a large subcutaneous vein, or in regions where there is much cellular tissue, as the scrotum or eyelids, lest troublesome hemorrhage or ecchymosis result. So also they should not be applied near a specific ulcer, lest their bites become inoculated by the discharge. The bleeding from a leech-bite should be encouraged by warm poulticing or fomentations for some time after the animal has dropped off. In this way from half an ounce to an ounce of blood may be taken by each leech. There is usually no difficulty in arresting the hemorrhage from the bite; should there be so, continued pressure with some scraped lint, felt, matico, or powdered alum, will accomplish this. If this do not succeed, as may happen in some situations where pressure cannot be conveniently applied, as on the neck and abdomen, particularly in young children, a piece of nitrate of silver scraped to a point, or a heated wire introduced into the bite, previously wiped dry, or a twisted suture over and around it, may be required.

Cupping is the most efficient local means of removing blood that we possess, and the quantity extracted may be regulated to a nicety in this way. It cannot, however, be employed upon the inflamed surface itself, on account of the pain and irritation that would be occasioned, and is consequently chiefly applicable to internal inflammations. As the scars made by the scarificators continue through life, cupping should not be practised upon exposed surfaces.

The inflamed part should always be placed in such a position as to facilitate the return of blood from it. Unless this be done, the pain is greatly increased, and the congestion augmented. Hence, it requires to be elevated on a level with, or above, the rest of the body. All motion and use must likewise be interdicted, as favoring determination and increasing pain.

In *cold* and *heat* we possess two most important local means of controlling inflammation. They cannot, however, be employed indiscriminately.

Cold:—There are two stages of inflammation in which cold may be employed with especial advantage; first, during the very early stages, rather with a view of preventing or limiting the inflammation, so that it may not pass beyond the bounds of adhesive action; and next when acute inflammation has passed off, the vessels of the part remaining relaxed and turgid: the application of cold acting as a powerful agent in restoring the tone of the parts.

Cold should never be had recourse to when these stages have passed, and when suppuration is coming on, or has set in; still less should it be employed when there is a tendency to mortification. Its long-continued and incautious use may indeed give rise to extensive sloughing of the inflamed part.

The modes of applying cold vary according to the part affected. If the surface be inflamed, evaporating spirit lotions, to which sedatives may sometimes be advantageously added, are the best. If it be wished to influence the whole substance of a limb, irrigation with cold water should be adopted. (Fig. 45.) If it be intended that the effect of the cold penetrate deeply, as in inflammations of the head, spine, or chest, it may be applied by means of pounded ice; to which, if an extreme degree of cold be required, salt may be added. The ice is best applied by being placed in a bladder, gut, or a Mackintosh bag, partially filled.

Warmth and moisture conjoined are of the utmost service in the treatment of inflammation. By these means, tension is relaxed, effusion is favored, and thus the over-distended vessels are relieved. If continued for too long a time,

however, these means favor congestion, and sodden the parts. Warm applications are especially serviceable in all cases of inflammation attended by much pain, more particularly if this occur from tension; and they are especially useful when suppuration is threatening, or has come on; and in many cases where there is a tendency to slough.

When abscess threatens, or the surface is broken, nothing affords so much relief as a well-made poultice, either of linseed meal or of bread; this made soft and smooth, and not spread too thickly on the cloth containing it, should be applied as hot as the patient can bear it.

Water-dressing, consisting of doubled lint, well soaked in tepid water, and covered by oiled silk, or thin gutta percha, extending from half an inch to an inch beyond it on all sides, may be advantageously substituted for a poultice if the sore be small, and the inflammation limited.

Fomentations of warm water, or of decoction of poppy and camomile flowers, applied by means of flannels wrung out of these liquids, or of bags containing the boiled plants, well soaked in the decoction, squeezed out, and applied hot, are very useful in extensive superficial inflammations. The flannels and bags should be well covered with oil-silk or Mackintosh cloth, so as to retain the heat, and to prevent evaporation. Spongiopiline may be used as a substitute for ordinary fomentations in cases in which the surface is unbroken.

These are the means by which acute active inflammation is arrested and cured. In their employment, we must endeavor to proportion the activity of our measures to the age, constitution, and vigor of the patients, the seat and intensity of the local disease, and continue them until the inflammatory action is not only arrested, but has entirely subsided, the part being restored to its ordinary healthy state.

TREATMENT OF CHRONIC INFLAMMATION.

The treatment of chronic inflammation is far more difficult and requires much more attention than that of the acute form of the disease. Chronic inflammation is so frequently complicated with various unhealthy conditions of the system, and with an impaired state of the general health, by which, indeed, it is often kept up, that much practical tact and skill are required in carrying out the therapeutic indications properly.

In the treatment of chronic inflammation we have not only to subdue inflammatory action, but also to remove structural changes and other effects induced by it. Hence, our object is not to produce a great and sudden impression on the system, as we are often required to do in the treatment of the acute affection. In this way chronic inflammation can never be cured, or its effects removed. The patient might be bled to death, and still the increased vascular action would go on in the inflamed part, so long as there was a drop of blood circulating in his vessels. It is true that the same antiphlogistic means are employed in arresting the chronic, as in cutting short the acute form of the disease, but in a less energetic manner; our object being to induce a gradual and continuous improvement in the state of the system and of the diseased part. Local nutrition is always modified in chronic inflammation, and this can only be restored to its normal condition by close attention to all the circumstances that tend to improve the patient's general health, as well as by producing an impression on the part itself by appropriate local means. Hence, in the treatment of chronic inflammation hygienic measures are of the first con sequence. In most cases nothing can be done without proper attention to these; and much by these that cannot be effected by any more direct medicinal means. The treatment of this form of inflammation must likewise be varied according as it is of an uncomplicated character, occurring in an otherwise healthy constitution, and assuming a sthenic type; or as it occurs in a cachectic and feeble

system, assuming a congestive or passive character, or as it is met with in an unhealthy constitution, and affects a specific form.

In the management of these various forms of chronic inflammation the patient must be kept at rest, and, if the disease be at all extensive, be confined to bed. He should be in pure air, and, as a general rule, be put on a light and unstimulating diet. The regulation of the diet is of much consequence, and the amount and quality of the nourishment afforded must be carefully proportioned to the age, strength, and previous habits of the patient, as well as to the degree and the seat of the inflammation, and the form of constitutional fever that accompanies it. In the more acute form of chronic inflammation, farinaceous slops, at most beef tea, and light puddings, can be allowed. In the less active forms occurring in feeble constitutions, with depression of general power, animal food may be given, of a light kind, and the scale of nourishment increased until stimulants, as beer, wine, or brandy, are allowed. Nothing requires greater nicety in practice than to proportion the diet, and to determine the cases in which stimulants are necessary. It may be stated generally that the more the disease assumes the asthenic and passive forms, the more are stimulants required; until, at last, in the truly typhoid type of inflammatory fever, our principal trust is in these agents; and large quantities of wine, brandy, and ammonia are required to maintain life.

Mercury is of essential service in the more active forms of chronic inflammation, but in all cachectic and strumous constitutions it should, as much as possible, be avoided. It is not only of great use in arresting the further progress of the disease, but especially in causing the absorption of some of the effusions that result from it, and in removing some of the other effects of chronic inflammation, such as thickening, hardening, and opacity of the parts. It should be given in small doses for a considerable length of time until the gums are slightly affected. In many cases of depressed power it may be very advantageously conjoined with bark or sarsaparilla. The most useful preparations are calomel in half grain or grain doses, the iodide of mercury in the same quantities; or if a gradual and continuous effect be required, the bichloride in doses of from $\frac{1}{16}$th to $\frac{1}{8}$th of a grain.

The iodide of potassium is an alterative and absorbent of the greatest value, especially in chronic inflammations of fibrous or osseous tissues, more particularly when occurring in strumous constitutions, in which it may often be substituted with great advantage for mercury, and given in those cases in which that mineral would otherwise be administered. In many cases it is of essential service after a mercurial course. Some days should, however, be allowed to elapse after the mercury is discontinued before the iodide is given, otherwise profuse salivation or even sloughing of the gums is apt to result.

Sarsaparilla is a very valuable remedy if obtained good, and forms an admirable vehicle for the preparations of mercury or iodine. The fluid-extract of red Jamaica sarsaparilla, carefully prepared, is that to which I give the preference; and where the inflammation is associated with want of power, its value is certainly very great.

The cod-liver oil is of the very greatest value in the various strumous forms of chronic inflammation; in debilitated, emaciated, cachectic, and strumous subjects; it may be given in some vehicle, such as orange-wine, or juice, that covers its taste. In some cases it is advantageously conjoined with the iodide of potassium, or, when there is much want of power, and strumous anæmia is present, with the preparations of iron. It is more particularly in children and young people that it is of service in removing the various effects of chronic inflammation.

Purgatives are often required in chronic inflammation. In robust subjects in whom the disease is active, salines may be employed; to which, if there be a rheumatic tendency, colchicum may advantageously be added. As a general

rule, warm aperients, such as the compound decoction of aloes, with Rochelle salt, answer best; and in children a powder composed of one part of mercury and chalk, two of carbonate of soda, and four of rhubarb will be found very serviceable.

LOCAL TREATMENT OF CHRONIC INFLAMMATION.

In chronic inflammation our local means of treatment are much more varied than in the acute form of the disease.

Local blood-letting is often required with a view of directly unloading the vessels of the part, and this is accomplished by scarification, leeching, or cupping. Scarification is principally employed in chronic inflammation of the mucous membranes. Leeches may very usefully be employed, in some forms of chronic inflammation, by applying two or three at a time and repeating this application every second or third day.

Warmth and moisture are not so serviceable in chronic as in acute inflammation, and care should be taken that they be not continued for so long a time as to sodden the parts. An astringent or stimulant, such as liquor plumbi or spirits of wine, may often advantageously be added to the warm application.

Cold is seldom required in any but the advanced stages of chronic inflammation, in which there is debility and passive congestion of the vessels of the part. In order to remove this state of things, its application should not be continuous, but be made twice or thrice a day, so as to occasion a sudden shock, and produce a constringing effect upon the enfeebled circulation of the part. This is best done by pumping or pouring cold water from a height, or by douching, and should be followed by active friction with the hands.

Friction is often of great service in some of the forms of congestive inflammation, and in the removal of the thickening, stiffening, and induration that results. Friction may be practised either with the naked hand or with some embrocation of a stimulating or absorbent character.

Counter-irritants are amongst the most energetic local means that we possess for combating chronic inflammation. Rubefacients, in the shape of stimulating embrocations, to which absorbents, such as mercurial ointment may often advantageously be added, may be usefully employed as adjuncts to friction.

By means of *blisters* applied either directly over the inflamed part, or at a little distance from it, the surface being kept raw and exuding by some stimulating application, effusions and those chronic structural changes that accompany the more advanced stages of inflammation may be absorbed.

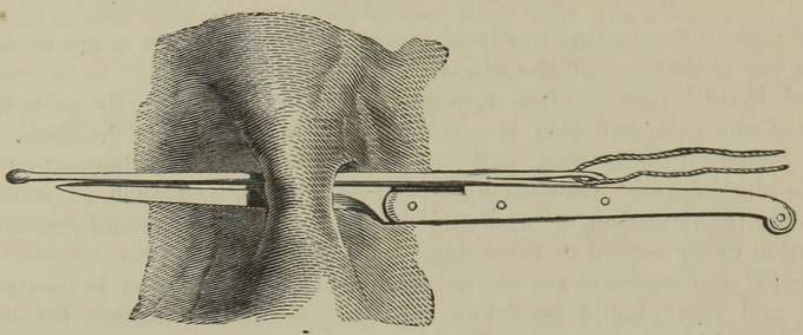
In the latter stages of chronic inflammation, the pyogenic counter-irritants may be very advantageously employed. By these a powerful derivative action is induced, and chronic thickening, may be melted away.

Issues are of especial service in chronic inflammation of the viscera, joints and bones; they should be applied in the soft parts over the affected structures, and may be kept open for a very considerable length of time. They are best made in the following manner: — A piece of common adhesive plaster, about two inches square, having a hole the size of a shilling cut in its middle, is fixed upon the part where the issue is to be made; a piece of potassa fusa, about the size of half a cherry stone, is then placed on the surface left uncovered by the circular central aperture, a square piece of plaster being laid over all. The patient experiences a burning pain for about two hours, when it ceases; on removing the plasters a black slough corresponding in size to the central aperture will be found. This must be poulticed for a few days until it separates, and the raw surface then dressed with savine ointment, or stimulated by an issue-bead. As it shows a tendency to heal, it may be kept open by the occasional application of the potassa fusa.

A seton when counter-irritation is to be applied over very deep-seated parts, is more useful than an issue. The seton may most conveniently be made in the

following way (fig. 46): — A fold of skin about two inches or more in breadth is pinched up, and its base transfixed by a narrow-bladed bistoury. The blunt end of an eyed probe, threaded with the seton, is next pushed along the back

Fig. 46.



of the blade from heel to point, which being withdrawn as the probe is carried onwards, the seton is left in the wound. A poultice should then be applied.

The actual cautery is especially successful in deep-seated chronic inflammation, as of joints, when a deep and prolonged action is required to be set up. The cauterizing irons may be of various shapes. They should be heated to a dull red heat and then quickly drawn in lines, crossing one another, over the part.

Astringents directly applied to the inflamed parts are of extreme service in those forms of congestive or passive inflammation in which the circulation is sluggish and the capillaries loaded, affording relief in these cases by inducing contraction of the vessels. In order to ensure their proper action they must be employed of sufficient strength, for if too weak they irritate, and increase rather than relieve the congested condition. The nitrate of silver is the astringent that is commonly preferred, and this applied either solid or in solution, of a strength from ten grains to one drachm of the salt to the ounce of distilled water, will produce a very marked beneficial influence in congestive inflammation of the mucous and cutaneous surfaces.

Pressure by means of well applied bandages, elastic webbing, or strapping, is of essential service in supporting the feeble vessels in congestive inflammations. In many cases pressure may be advantageously conjoined with absorbents and rubefacients, as mercurial and camphor liniment, or the plaster of mercury and ammoniacum. This treatment, by removing congestion and promoting the absorption of inflammatory effusion, is especially useful in chronic forms of inflammation accompanied by thickening of parts, as in the joints and testis.

Having now discussed the treatment of ordinary sthenic inflammation in its acute and chronic forms, we must next say a few words on the management of the *asthenic* and *irritative* varieties of the disease. These forms of inflammation derive their peculiarities more from the character of the constitutional disturbance that accompanies them, than from any peculiarity in the local affection. Hence it is not in the topical treatment of the disease, but in the management of the constitutional condition, that the principal difference exists between this and the other varieties of inflammation.

In considering this part of our subject, it is of especial importance to banish the term "*antiphlogistic*;" for the same treatment that would be anti-inflammatory in one form of the disease, would certainly favor its progress in another. Here we must be entirely guided in the means that we adopt by the condition of the patient and the character of the symptoms. If these from the first partake of the asthenic or irritative type, we cannot at any period have recourse to the treatment that has been recommended in sthenic inflammation. If the disease commence in an active form, the fever progressively assuming a lower

and lower character merging into the asthenic and irritative conditions, so must we gradually alter the nature of our general treatment, which is always a delicate procedure, requiring much caution. Though the inflammatory fever may at first assume the sthenic form, if there is reason to believe, from the broken constitution of the patient, or from the congestive or passive character of the local inflammation, that the constitutional symptoms will not long continue of this type, we must be extremely cautious how we lower the patient by active depletion; for however high the fever may at first run, and in these cases there is often febrile disturbance of a very active character for the first few days, the disease speedily expends its force and rapidly subsides into a low form. In such cases as these, which are of very common occurrence in London practice, more particularly in hospitals, we should never bleed, but content ourselves, after clearing out the bowels, with keeping the patient quiet on a moderate or low diet, and administering diaphoretic salines. As the symptoms gradually merge into the typhoid type, the pulse with increasing frequency diminishing in power, the tongue becoming dry and dark, and the other symptoms of asthenia beginning to show themselves, we must begin to give some stimulant in combination with the salines. The carbonate of ammonia in five to ten grain doses, or even more, may be given in an effervescent form, with fifteen grains of the bicarbonate of potass and a sufficient quantity of citric acid, every third or fourth hour. The nourishment must be increased; and wine or alcoholic stimulants must be conjoined with it in proportion as the symptoms of debility become more and more urgent. In effecting this change we must be careful not to run into the error of over-stimulating our patient; this may be avoided by observing the influence exercised on the pulse and tongue by the change in treatment.

In the majority of cases this stimulating plan is not well borne during the first few days after the setting in of an inflammation; but when the more active symptoms show a tendency to subside, when the bowels have been well cleansed out and the skin is beginning to assume a slight degree of moisture, then it may be resorted to with every success.

In many cases, however, it happens that the symptoms so rapidly sink into, or, from the very first, assume so asthenic a character, that the only treatment that holds out a chance of saving the patient's life consists in the early and free administration of tonics and stimulants, with mild nourishment; such as ammonia and bark, wine, brandy, or porter, with beef-tea and arrowroot, and of these, large quantities may be required in the four-and-twenty hours; the patient evincing a tendency to sink whenever their use is interrupted. The brandy and egg mixture of the pharmacopœia, if well made, combining as it does nutriment and stimulus, is the best remedy that can be administered in many cases.

Under this plan of treatment the tongue will be found to become moist, the brown sordes to clear off from the inside of the mouth, the pulse to become steady and full, sleep to be procured, and the strength maintained. The more I see of surgical inflammation the more confidence do I feel in this stimulating plan of treatment, which is the only method of carrying patients through those low forms of inflammation that are so frequent in hospital practice. The liability to these inflammations will also be materially lessened by the early employment of a stimulating plan of treatment after injuries and operations.

As the asthenic passes into the irritative form, we may find it necessary to conjoin opiates with the general treatment.

In the lower forms of inflammatory fever, congestive pneumonia and asthenic bronchitis frequently supervene. In this complication, the following draught may be advantageously given every third or fourth hour:—℞ Tinct. Camph. comp., ℥ 20 to 30, Ammoniæ Carbonatis gr. v. to x., Decocti Senegæ, ℥iss., with rubefacients, blisters, or dry cupping to the chest. The diarrhœa that not unfrequently occurs, must be met with opiates and astringents; and if the urine cannot be passed, it must be drawn off by the catheter.

SECONDARY FORMS OF INFLAMMATION.

Inflammation, if it do not terminate by resolution, passes from the forms that have just been described, into others of a secondary character. These are:— 1st, the Effusive; 2nd, the Adhesive; 3rd, the Suppurative; 4th, the Ulcerative; and, 5th, the Gangrenous inflammations.

Effusive Inflammation.—Effusions are not invariably the consequences of inflammation; serum and blood are often poured out independently of it. In a natural and healthy state, effusion or transudation of a watery fluid is constantly going on in all parts of the body through the walls of the capillaries, this *plasma* serving an important purpose in the nutritive actions of the tissues which it bathes. It is only when this is increased in quantity and altered in composition, that it becomes a diseased product, constituting *œdema* when occurring in the cellular tissue, and *dropsy* when accumulating in serous or synovial cavities. The fluid that is thus exuded in sufficient quantity to accumulate, is of a watery character, being neither liquor sanguinis nor serum, not containing the fibrine of the one, or the proportion of albumen and salts of the other. Its transudation is generally dependent upon venous congestion. Thus, if the veins of the leg are compressed, œdema of the foot will occur; if those of the liver suffer pressure, ascites will result; or if the renal veins are obstructed, albuminuria will ensue.

If the pressure on the vessels be still greater, the capillaries may become distended till they rupture, giving rise to effusion of blood, as in some forms of epistaxis and hematuria.

Now, in inflammation, an increased degree of pressure exists in the inflamed parts, the vessels being over-distended as well as dilated, and blood continuing to be pumped with augmented activity against those that are already turgid; hence there is a mechanical tendency to the occurrence of some effusions, and a disposition for the inflammation to relieve itself by the distended vessels pouring out some of their contents. But though effusions in inflammation are partly mechanical, they are not by any means wholly so; for, in many cases, organizable matter and organisms appear, which did not previously exist, and which are produced by the local actions of the part.

The proper effusions of inflammation are—1st, blood; 2nd, liquor sanguinis; 3rd, serum; and, 4th, secretions of tissues or organs. These effusions are in a great measure mechanical, depending on the dynamic state of the vessels; though, doubtless, in many instances, modified by other causes of a vital character. Fibrine, or lymph, though usually spoken of as an inflammatory effusion, differs so remarkably in its vital characters from the rest, and is so evidently a new formation, that I shall consider it separately.

The frequency with which one or other form of effusion occurs in different tissues, or organs, varies greatly. Paget observes, "each tissue has its proper mode and products of inflammation;" hence particular kinds of effusion are very rare in some, although of common occurrence in other parts.

1. *Effusion of Blood* often occurs in small quantity, tinging the other products of inflammation. When this is the case, the coloring matter is broken down and dissolved, a condition indicative of a low state of the constitutional powers. In other cases, the hemorrhage may be abundant, the character of the blood being but little changed. This effusion is dependent upon over-distension of the vessels, with softening of the tissues, giving rise to rupture of the capillaries, without which it cannot occur, there being no such thing as *transudation* of blood in inflammation. Hemorrhage of this kind most frequently occurs from mucous surfaces, which readily bleed when inflamed. It may also happen from the rupture of new vessels in freshly-deposited lymph.

2. *Effusion of Liquor Sanguinis.*—In this case the fluid parts of the blood

transude, leaving the red corpuscles behind. It is occasionally met with in so-called serous effusions, into the tunica vaginalis, for instance; so also the serum contained in the bleb of a blister is really liquor sanguinis; and Paget has found that in this there is more fibrine when there is most strength of constitution. This fluid is not uncommonly met with in the subcutaneous and submucous cellular tissues; about the glottis, and in the scrotum, for instance, giving rise to a gelatinous semi-transparent swelling of the part. In these cases, the more fluid portions are sometimes absorbed, leaving the fibrine behind, then constituting the condition termed *solid œdema*. The fibrine in this effusion often does not coagulate so long as it is retained in the body, but when once it is removed solidification ensues.

3. *Serous or albuminous effusions* are very common in inflammations of a slight or subacute form, of serous and cellular tissues, giving rise to dropsies and œdema. They most frequently contain a small admixture of fibrine, approaching somewhat to the characters of the last-mentioned effusion. The quantity of the fibrine contained in them is usually a measure of the degree of the inflammation. These serous accumulations form and are absorbed with great rapidity, and their absorption is usually most rapid when the fibrination is least.

4. *Secretions of tissues and organs* undergo changes in quantity and quality, under the influence of inflammation. The quantity is at first increased; but during the active stage of the inflammation, when there is much tension, it becomes diminished, the part being almost dry; as the inflammatory action subsides, and relaxation of the vessels ensues, it again becomes increased.

The alteration in quality in secretions from glands, is chiefly due to the admixture of morbid secretions from the mucous membrane. When a serous membrane is inflamed, the secretion not only accumulates in greatly increased quantity, as in acute hydrocele, but it becomes turbid by the admixture of flakes of lymph, which are sometimes so abundant as to give it a puriform appearance. In other cases true pus is formed, as in inflammation of the anterior chamber of the eye, terminating in hypopium.

In inflammations of the cellular tissue, the quantity of fluid is either simply increased, or it becomes fibrinous, occasioning solid œdema and induration.

In inflammation of the mucous membranes, the most important modifications of secretion occur. The first effect is to cause the transudation of a serous fluid from the mucous membrane, the secretion becoming clear, watery, and abundant. As the inflammation increases, exudation-corpuscles and large quantities of epithelial scales are thrown off, and mixing with the mucus, make it viscid and tenacious, *ropy* as it is termed. In the more advanced stages, we find pus, and exudation-corpuscles, with epithelial scales, constituting the various forms of muco-pus, and of true purulent secretion.

ADHESIVE INFLAMMATION.

The *adhesive* is that form of inflammation which terminates in the effusion of fibrine, lymph, or plastic matter; it may hence be termed fibrinous or plastic inflammation.

The study of the products of this form of inflammation is of great importance, not only because they form the basis of adhesive action, but that they are the media from, by, and in which all the reparative effects of inflammation take place, and the reconstruction of destroyed tissue is effected. Lymph, the material of repair employed by nature, has an independent and inherent vitality by which it is organized, irrespectively of the forces of the parts around it. It is capable of development into various tissues, and of degeneration into structures lower in the scale of organization. Many of the ulterior

products of inflammation being but instances of the development or degeneration of lymph.

Although lymph is usually observed by the surgeon in a semi-solidified form, hence often termed "*coagulable lymph*," it must necessarily be separated from the vessels in a fluid state. This separation is not a mechanical act, but a vital phenomenon, analogous perhaps to the process of nutrition, by which a living organized fluid, possessing within itself the power of self-development, and of organization into tissues, is separated or eliminated from the blood. It is this fibrine, lymph, or plastic matter that plays so important a part as a reparative agent in surgery; that is seen as a covering to the surface of recent wounds, glazing them in a few hours, and causing speedy union to take place between their opposed sides through its intervention.

Characters of Lymph.—The plastic (Williams) or fibrinous (Paget), and the aplastic (Williams), croupous (Rokitansky) or corpuscular (Paget), are the two varieties under which lymph is presented to the surgeon.

The fibrinous or plastic, is the true healthy coagulable lymph. When first poured out it is liquid, but it speedily coagulates into a whitish, greyish, or yellowish-white, elastic, semi-transparent substance, somewhat resembling the buff of coagulum. Chemically considered, it is not composed of pure fibrine, but contains an admixture of oily and saline matters, which are necessary for its development. This form of lymph is only met with in healthy and vigorous individuals, usually as the result of inflammation consecutive upon cleanly-cut wounds. Under the microscope it appears filamentous in structure, being made up of delicate interlaced fibrillæ.

The corpuscular, aplastic, or croupous lymph differs remarkably from the variety that has just been described. In this, coagulation does not take place, but corpuscles float free in a thin, clear, serous liquid. This variety of lymph is met with in, and is indicative of, cachectic states of the system. The corpuscles which characterize it, commonly go by the name of *exudation-cells;* they resemble in general characters the white corpuscles of the blood, or those met with in the fluid contained in the lymphatic vessels. Gulliver states, however, that exudation cells are larger and more irregular in size and shape than these, and usually exhibit from two to three nuclei when treated with acetic acid. They form in about four-and-twenty hours after inflammation has been set up; and may either develop, passing upwards through fibro-cells, caudate-cells, &c., into filaments; or, degenerate into pus-corpuscles, granule-cells, granular matter, and débris.

These two primary forms of lymph, the fibrinous and the corpuscular, are almost always found together, but existing in various proportions in the same exudation mass; the relative quantity of the one or other element determining whether it shall undergo development or degeneration. Paget observes that "the greater the proportion of fibrine in any inflammatory exudation, the greater is the likelihood of its organization." This preponderance of fibrine being indicative of adhesive inflammation. And "the greater the proportion of corpuscles, the greater the probability of suppuration or of degenerative process." The preponderance of corpuscles indicating suppurative inflammation.

Why does lymph at different times assume different forms, fibrine preponderating in some, corpuscles in other cases? Or, in other words, why have we a tendency to adhesive inflammation in some, to suppurative inflammation in others? This question, which has been closely investigated by Hunter, Bichat, Rokitansky, and Williams, has been very clearly replied to by Paget as referable to three causes. 1. The state of the blood; 2. The seat of the inflammation; 3. The degree and character of the inflammation.

1. *State of the Blood.* — Paget applied blisters to thirty different patients, and collected the sero-fibrinous fluid that accumulated in the blebs. In those

who were suffering from purely local diseases, the constitution being otherwise healthy, the fibrine was firm, filamentous, and elastic; in cachectic or phthisical patients it was almost wholly corpuscular, with every intermediate variety, according to the condition of the system. As a general rule in young persons, and in those of sound constitution, the fibrine is plastic; hence it is in these individuals that we may chiefly look for the union of wounds by adhesive inflammation.

2. The *seat* of inflammation modifies its product very considerably, as Bichat and Hunter long ago pointed out. Serous membranes are prone to fibrinous — the mucous to suppurative inflammation; and in cellular tissue, both fibrine and corpuscles are found. This general rule, however, is subservient to the state of the constitution, and to the influence of certain specific diseases. Thus in diphtherite and croup, lymph is poured out on the mucous membrane of the throat; whilst in empyema, pus is formed in the cavity of the pleura.

3. The *degree* and *character* of the inflammation modify considerably the product. In slight inflammations it is almost always corpuscular; in the more acute and active, of a fibrinous character. Certain *forms* of inflammation are always attended by specific products. In pyemia, for instance, all the products have a suppurative tendency, even when serous membranes are inflamed. In croup, on the other hand, there is a disposition to plastic effusion even on mucous surfaces.

After-changes in lymph.—Lymph that has been poured out is susceptible of three important changes, viz., absorption, development, and degeneration.

When lymph undergoes absorption, it probably breaks up and dissolves in the fluids of the part, being carried off by the vessels; these changes we not unfrequently see taking place in an inflamed eye.

Development of lymph. —In a healthy constitution and with a healthy local condition, lymph evinces an upward tendency in the scale of development, becoming vascular, and being converted into a fibro-cellular material. This development may be arrested by the three following conditions: viz., the state of the patient's health; the continuance of the inflammation; and a congestive state of the part itself.

If the health be impaired or broken, all development ceases; this process being essentially dependent upon constitutional force and vigor. Hence the necessity of maintaining the patient's powers if we look for healthy and complete reparative action in a part.

The continuance of inflammation beyond a certain point in intensity, prevents the development and proper organization of lymph. Thus, in an ulcer which becomes inflamed, all reparative action is at once arrested, and the lymph already deposited may retrograde or become absorbed. This property in local inflammation of imprinting a retrograde course upon lymph that has already been deposited, is taken advantage of by the surgeon, who dissolves away a hard and chronic thickening of a part by exciting inflammation in the centre of it with potassa fusa.

Local congestion of a part effectually prevents the deposit of lymph. Thus, no reparative action takes place in an ulcer seated on a congested limb.

In undergoing development, lymph always passes into the fibro-cellular state, beyond which it very frequently does not proceed. This fibro-cellular tissue so formed, is the common connecting medium of wounds, and the tissue of which cicatrices are composed; we see it on the face of a stump binding together all the tissues, muscles, nerves, and vessels in one common bond. It is of this fibro-cellular substance that adhesions, bands, false membranes, thickenings, and opacities are commonly formed.

Plastic matter may also be developed into bone, passing through a fibrous, or fibro-cellular transformation; and, lastly, we see it developed into epithelial scales, such as are commonly found in cutaneous cicatrices.

Vascularization of lymph. — In lymph that undergoes development, blood-vessels are seen to make their appearance at an early period. With regard to the precise time of their formation, Dupuytren and Villermé state, from their experiments on dogs, that twenty-one days are required; and Travers, from his experiments on the frog's web, fixed the same period as that in which red blood begins to pass. In the human subject, however, the lymph on the surface of an ulcer or wound certainly appears to become vascular long before this.

How are the new vessels formed? — by development in the lymph? or by extension from surrounding parts? Hunter and Rokitansky incline to the former opinion. Travers and Quekett, who have recently investigated the matter fully, believe that the vessels are always projected into the lymph from neighboring parts; and Paget agrees with these observers. Travers states distinctly, as the result of his observations, which are borne out by the results of the experiments of the late Dr. Todd, that "there is no such thing as independent vascularization, the whole business of organization is of and from the margin of the wound."

According to Travers, the following are the periods of development of vessels in a frog's web which had been wounded:—

Up to the fourteenth day, there is stasis in the vessels adjoining the wound. From the fourteenth to the twenty-first day, channels are opened in the plastic matter, at first colorless, then admitting single blood-corpuscles; from the twenty-first to the twenty-eighth day, the circulation is more active, the vessels enlarging and anastomozing; in the fifth week, transparent capillaries pass across from the colored arteries to veins; and in the sixth week there is the formation of new vessels in loops, half-circles, &c.

The steps by which this interesting process is accomplished, are the following. At first, small lateral dilatations or pouches appear at some points on the walls of the nearest old vessels; these grow out into the plastic mass, bend towards each other, coalesce, and form a loop or fork. These loops give rise to secondary vascular outgrowths; and thus the vascularization of the lymph is completed.

Travers states that these vessels are visible, like fine striæ, before the circulation can be detected in them. A single globule of blood first enters, this is followed by others, which for some time have a see-saw or oscillatory motion, which progresses gradually towards the nearest vessel, and the blood entering this completes the circulation, which becomes continuous and equable.

The *degeneration* of lymph has been especially studied by Paget. He observes that it may wither and harden, forming dry, horny masses or vegetations; that it may undergo fatty degeneration, and become converted into granular matter. These two last forms of degeneration are frequently met with in the coats of diseased arteries. Besides these changes, it may calcify, being converted into an inorganic earthy material; it may undergo pigmentary changes; and, lastly, it is very frequently converted into pus.

SUPPURATIVE INFLAMMATION.

The *suppurative* is that form of inflammation which gives rise to the production of pus; and pus never occurs except as the result of this form of inflammatory action.

Pus presents considerable variety in its general character, according to the nature of the constitution of the patient, or the condition of the part in which it is formed.

When formed in a person of healthy constitution, as the result of sthenic inflammation, it is an opaque, creamy fluid, thick, smooth, and slightly glutinous to the touch; of a yellowish-white color, with a greenish tinge, having a faint odor, and an alkaline reaction. Chemically, it is composed of water containing albumen, fibrine, saline, and fatty matters in solution and admixture, and usually gives off a small quantity of ammonia. Pus presenting these characters is termed *healthy* or *laudable*.

When admixed and tinged with blood, it is said to be *sanious*. When thin, watery, and acrid, *ichorous;* when containing cheesy-looking flakes, it is termed *curdy;* and when diluted with mucus or serum, it is frequently called *muco-pus*, or *sero-pus*. Besides these, pus presents many other varieties. Thus, for instance, when formed from bone, or in the neighborhood of the alimentary canal, it has a peculiar fetid odor. Its chemical composition may likewise vary under different circumstances; thus, ordinary pus formed in the soft parts, contains merely a trace of phosphate of lime, whereas that which is formed in connection with diseased bone has been found by B. Cooper to contain $2\frac{1}{2}$ per cent. of this salt. Sometimes animalcules are found in pus; vibriones are met with in some kinds of pus from the genital organs. Pus presents other peculiarities, which are only cognizable by their effects on the system; thus, the pus from specific sores possesses contagious properties, though in chemical, microscopical, and physical constitution, it does not differ from other forms of that fluid.

On examining pus under the microscope, it is found to consist of corpuscles floating in a homogeneous fluid, the "liquor puris." These corpuscles appear to be modifications of the exudation-cell, being composed of a semi-transparent cell wall, containing two or three nuclei, which are rendered very apparent by acetic acid. Besides these, a large quantity of granular matter, of particles of fibrine, of disintegrated exudation-cells, are usually found admixed with it. The greater the quantity of corpuscles, the richer and more creamy is the pus.

In many cases, the microscopical characters of pus differ, however, from those that have just been given. Thus, in the thin, greasy, yellowish-looking pus, somewhat resembling melted butter, that we find in the joints in pyemia, the pus-corpuscles are irregular in outline, and not so distinctly nucleated; and in some forms of chronic abscess, when the pus is thin and curdy, the pus-corpuscles present a somewhat similar appearance, undergoing fatty degeneration.

Fig. 47. Healthy pus-cells. Figs. 48, 49, 50. Various forms of pus-cell from phlebitis and pyemia. Fig. 51. Pus from a scrofulous abscess.

Fig. 47.

Fig. 48.

Fig. 49.

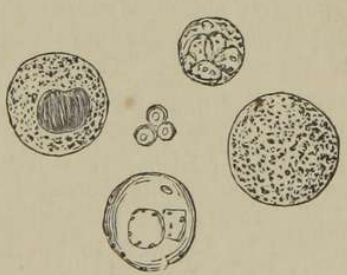


Fig. 50.

Fig. 51.

Pyogenesis, or the formation of pus, is an interesting study. The older surgeons believed that this fluid was formed by the breaking up or disintegration of the solid tissues, or that it was the result of their liquefaction or saponification by the acid products of inflammation. Quesnay and Haller exposed the fallacy of these opinions, and modern pathologists look upon pus as a direct product of inflammation.

Pus-cells have been shown by recent observers to be modified or degenerated exudation-corpuscles, and the fluid in which they float to be of a serous character. In many cases the transition from lymph to pus-cells can be seen to take place; thus Paget has observed that the fluid contents of the vesicle of herpes, which are corpuscular exudation-matters, become purulent in twenty-four hours. So, again, every surgeon must have repeatedly observed that, in cutting into some forms of abscess in their early stages, a sero-plastic fluid escapes, which, in the course of a day or two, becomes purulent. So likewise in amputating in the vicinity of an inflamed part, the tissues appear to be infiltrated with gelatinous exudation-matter, which, in the course of a few hours becomes converted into pus.

Pus may be formed on the free surface, or in the substance of parts. The first constitutes *a purulent secretion;* the second *an abscess.*

When formed on a free surface, whether this be serous or mucous, the pus cells appear to be modified exudation-corpuscles floating in the watery effusions of the inflamed part.

When pus forms in the substance of a tissue, or organ, constituting an abscess, there is in the first place a high degree of inflammatory action. Sero-plastic exudation is thrown out, infiltrating the tissues, and in the centre of this, where the inflammation attains its greatest intensity, the exudation-cells become transformed into pus-corpuscles. A drop of pus is thus formed in the inside of the exudation-matter already effused, or at the moment of its evolution, as the result of changes imprinted on it by contact with the inflamed parts Around the pus thus formed, the lymph deposited in the substance of the tissues, and filling up their interstices, forms a consolidated mass, which plays an important part in limiting the further extension of the suppuration. As the suppurative action advances, the corpuscles composing the innermost layers of this plastic mass, gradually transform into pus-cells; the blastema degenerating into liquor puris. The purulent accumulation thus formed, constituting an abscess, is always retained in healthy states of the system, by an external boundary of consolidated lymph, which extends itself on its outside by fresh deposits, and by the liquefaction and metamorphosis of its interior, as the central accumulation of pus increases.

This boundary of lymph has been termed the *Pyogenic membrane*, and was supposed by Delpech to be the secreting organ of pus. This, however, it is not; and that it is not necessary for the secretion of pus, is shown by the facts that it is not found in the early stages of suppuration; that on free surfaces suppuration occurs without it, and that it is absent in certain kinds of abscesses, the diffused and the metastatic. A better term for it would be the "limiting fibrine," as it limits or bounds the spread of suppurative action. Its absence is usually indicative of a want of power in the system; the suppuration then becoming diffused, extending itself indefinitely through the cellular tissue.

The *diagnosis* of pus is usually easy, but some fluids resemble pus so closely to the naked eye, that the microscope becomes necessary to establish their true characters. From *healthy mucus* there is no difficulty in distinguishing pus, but when mucus has been thickened and rendered opaque by inflammation, and is mixed with exudation-cells, it is impossible, and can never be necessary, to distinguish it from pus.

Turbid serum, containing broken-down and granular fibrine, frequently met

with in serous sacs, closely resembles pus; here the diagnosis may be effected by the absence of cells.

Softened fibrine, as in clots and inflamed vessels, often closely resembles pus to the naked eye, but the microscope reveals the true nature of the fluid by the absence of exudation-cells.

Atheroma may be distinguished from pus by the presence of cholesterine, granules and fat, and by the non-existence of the characteristic pus-corpuscle. In *tubercle* and *cancer* the absence of the true pus-cell, and the presence of appearances characteristic of these morbid products, establish the diagnosis.

When admixed with blood the detection of pus is often very difficult, and, indeed, cannot in many cases be satisfactorily accomplished; the white corpuscles have sometimes been mistaken for its cells, to which they have a great resemblance.

When diffused in milk, as in some forms of lacteal abscess, the corpuscles of this fluid will be seen to be smaller and clearer, with a more defined outline than those of pus.

Suppuration varies greatly as to *duration*. Inflammation very commonly terminates in the formation of pus, in the course of about three days; at other times a much longer period than this is required, the inflammatory action being of a passive and languid character. When once suppuration has been set up, it may continue for an indefinite time, pus becoming, as it were, the established secretion of the part. It is not uncommon to find purulent discharges from mucous membranes continuing for years.

The *characters* of suppurative inflammation vary according as it is healthy, unhealthy, or specific.

The Symptoms of suppuration are local and constitutional. The local symptoms differ as the suppuration occurs on a mucous surface, or in an internal cavity, or organ.

When an inflamed mucous surface is about to suppurate, the membrane presents the ordinary characters of active inflammation, being swollen, red, and often painful; to these a discharge is speedily superadded.

When suppuration is about to take place in the substance of tissues or organs, the local symptoms of inflammation undergo certain modifications indicative of the supervention of this action. The pain becomes throbbing, the part swells and becomes tense, but after a time softens; and fluctuation or undulation may be detected in it. The skin becomes glazed, red, shining, and œdematous. In other cases, again, suppuration occurs without any evident local sign of inflammation, the presence of the pus revealing itself by swelling and fluctuation only.

Constitutional Symptoms. — On the supervention of extensive suppuration, the ordinary symptoms of inflammation subside, and are usually interrupted by the occurrences of chills, alternations of heat and cold; or if the formation of pus be extensive, by severe and long-continued rigors. The fever often assumes a somewhat intermittent character, and its intensity lessens, the pulse becoming soft, though continuing quick. If pus be formed in sufficient quantity for its discharge to act as a severe drain on the constitution, another set of symptoms speedily sets in, dependent on the loss that is going on. The patient becomes weak, his nutrition is impaired, and *hectic* is established.

Hectic does not come on unless there is a discharge of pus from the system. No hectic occurs so long as an abscess, however large, continues unopened; but it supervenes with great rapidity when once its contents are discharged. I have known a large abscess exist unopened for two years, without any constitutional disturbance, but so soon as it was opened, well marked hectic set in, which speedily carried off the patient.

Hectic is essentially a fever of debility, conjoined with irritation. Emaciation and general loss of power invariably accompany it. The pulse, which is quick, small, and compressible, rises from ten to twenty beats above its normal

standard; the tongue becomes red at the edges and tip; the cheeks are often flushed, and the eyes glistening, with a dilated pupil; all these symptoms have a tendency to exacerbations after meals, and towards evening. There is also increased action, either of the skin, bowels, or kidneys. Thus profuse sweating, copious purging, and abundant red deposits in the urine take place; these discharges often alternate with one another, melting the patient away, and hence are termed *colliquative*. The debility gradually increasing, the patient rapidly wastes, and at last dies from sheer exhaustion, the conjoined result of fever, mal-nutrition, and wasting discharges.

In some cases of extensive suppuration, especially in children, hectic does not occur, but marasmus or atrophy takes place instead, the child wasting away without fever, and being carried off at last by exhaustion or some intercurrent disease.

Inflammation tends to suppuration under the influence of conditions very similar to those that give rise to the formation of corpuscular rather than fibrinous lymph. Indeed it must be borne in mind that there are no very definite limits between these two products of inflammation,—exudation corpuscles and pus cells. We see that, in a sore, the same action will generate cells that very closely resemble one another. Some of these are exudation, becoming organized; others again are pus-corpuscles, and become eliminated.

1st. The state of the patient's health exercises a great influence on the probable tendency to suppuration. The sounder the constitution the less the chance of inflammation running into the suppurative form. And indeed we may often, in surgical practice, look upon the suppurative tendency of wounds as a measure of the state of the patient's health. Thus, in scrofulous constitutions, the inflammation that is excited by a trivial injury, as the sprain of a joint, for instance, is very apt to run on to suppuration. So again, in certain cachectic states of the system, slight wounds suppurate, or fester, as it is termed.

2nd. The specific character of the inflammation often determines the supervention of suppuration; some diseases, such as gonorrhœa and purulent ophthalmia, consisting essentially in the secretion of pus by a free surface.

3rd. The seat of inflammation also exercises considerable influence. Thus mucous membranes when inflamed almost invariably suppurate, the transition from their normal secretion to pus being very readily effected. Serous membranes do so but rarely; the puriform fluid secreted by them when inflamed being in most cases nothing but turbid serum.

4th. The more intense the inflammation the greater the liability to the formation of pus; hence pus usually forms in the centre of inflamed parts. When the inflammation is of an active sthenic character in a healthy constitution, it requires considerable intensity to give rise to suppuration. It is only where the system is strongly predisposed by struma or cachexy that very slight inflammations terminate in this way. The degree of inflammation required for the formation of pus varies greatly, but it is always greater than that necessary for plastic exudation.

5th. The local condition of the part influences the probability of suppuration. Thus a subcutaneous wound, as in tenotomy, does not suppurate; but if it be opened, and its interior exposed to the air, then degeneration of exudation-cells, which constitutes their conversion into pus, takes place. For the same reason all ulcers suppurate. The lodgment of foreign bodies, as of urine, a piece of bone, or a bullet, by exciting intense and continuous inflammation, almost inevitably leads to suppuration, which is indeed the means adopted by nature for their removal from the system.

The *treatment* of this form of inflammation is divisible into local and constitutional.

The Local Treatment presents three indications.

First, the removal of the cause; as by extracting a piece of dead bone from the bottom of a sore.

Secondly, lessening inflammatory action by appropriate antiphlogistic means, and thus either removing the inflammation entirely, or confining it within those limits that are compatible with the effusion of plastic matter.

The third indication consists in facilitating the escape of the pus, if it be lodged in tissues or deep cavities, and in moderating or arresting the amount of its discharge, when it is poured out from a free surface by the use of astringents of various kinds, or by the proper employment of pressure.

Constitutional Treatment.—With the view of preventing the occurrence of suppuration, a general antiphlogistic treatment must be employed in the earlier stages of inflammation; but as the drain on the system may eventually be considerable, we must be careful not to push these measures with too much activity. After the discharge has taken place, nourishing, tonic, and even stimulating treatment will be required in proportion to the amount of debility that is induced. Amongst the most useful medicinal agents are mineral and vegetable tonics, the mineral acids, and cod's liver oil. Attention to hygienic conditions, with change of air and residence at the sea side, are also most valuable. When hectic comes on, the same general tonic plan must be adopted, whilst we have recourse to means adapted to meet the special symptoms. Thus, acids are required to check the sweating, astringents to arrest the diarrhœa, and as much mild nourishment as the patient will bear, to support the strength.

ULCERATIVE INFLAMMATION.

The *Ulcerative*, is that form of inflammation which terminates in the formation of an ulcer. An ulcer may be defined to be a solution of continuity, with loss of substance; a cavity or hole slowly produced by some action going on in the part itself, or suddenly, by chemical agents, destroying the textures, and attended by the secretion of pus. It is that process by which nature separates parts that have, from whatever cause, lost their vitality, and is diametrically opposed to adhesive inflammation, being attended by an absorbing, and not a depositive action. There are two distinct stages described as constituting the process of ulceration, attended by the most opposite phenomena; viz., 1st, the period of destruction; 2nd, the period of reparation. To the first only can the term be properly applied, the stage of repair being one of deposition. The process of ulceration must always be confined to the surface, and cannot occur within the texture or substance of parts. It is most common on the cutaneous and mucous surfaces, but likewise occurs on the lining membrane of blood-vessels and on serous membranes.

In what does ulceration essentially consist? Is it simply an arrest of nutrition; a cessation of the deposition of new materials, whilst the old ones are removed, a passive state in which absorption is normal, and deposition imperfect? Or, is it an active condition of the absorbents, deposition being normal, but absorption being carried on with too great vigor? or, lastly, is it a process of disintegration, of elimination, of ejectment of spoiled and dead matters; a detachment of the disorganized soft tissues, as we see occurring in sloughing ulcers or in the removal of carious bone, in its disintegration by pus? Probably all these conditions enter into ulcerative action, but more especially the latter. It might be supposed that the precise share that each takes could be determined by a reference to the agency by which ulceration is affected; whether by the absorbents or by the veins; but this cannot be determined at present; and that ulceration occurs independently of either set of vessels is evident, from the fact that it is met with in parts, as the cornea and in cartilage, where neither exist. Doubtless, in many cases ulceration consists essentially in the disintegration, softening, breaking down, or, as it has been termed, the "mole-

cular death" of the tissues, and the detachment of these spoilt matters by a peculiar action of the subjacent living structures.

There are certainly two conditions in which ulceration may occur;—with, and without, inflammation. Inflammation may give rise to ulceration in two ways:—1st, by directly softening and disorganizing the structures; and thus occasioning the more rapid or acute forms of ulceration, that are accompanied with much sloughing and signs of active inflammation, great pain, heat, and redness. 2d, by chronically modifying nutrition, inducing induration and plastic infiltrations, which, under the continuance of the inflammatory process, soften and break down, becoming converted into ill-organized pus, mixed with the débris of the part.

Tissues that have been congested for a long time are apt to inflame under the influence of some trivial exciting cause, and rapidly to run into ulceration. This usually commences in the centre of the part, where the nutrient action is lowest; here a small sore forms, which exudes thin unhealthy pus, and rapidly extends. So long as the sore is inflamed, it continues to spread, and reparation cannot go on in it. It would appear as if a moderate degree of inflammation were too intense for the vitality of chronically congested tissues, or those in which lowly-organized fibrine has been effused. The more the vitality of a tissue is reduced, the less appears to be the degree of inflammation that is required to produce disintegration and ulceration of it. Indeed, if the vitality of a part be sufficiently lowered, it may fall into a state of ulceration without the occurrence of inflammation, or with so slight a degree as scarcely to be appreciable; the ulcerative action appearing to arise from disintegration dependent upon the want of nutrition. Thus, for instance, in scrofula and in other diseases, as scurvy or syphilis, where there is an imperfect nutritive force, a tendency to softening and breaking down of structure, and consequent ulceration occurs; and these tendencies are much increased by the occurrence of congestive or subacute inflammation in the part.

Ulceration is so intimately allied with sloughing and gangrene, that it is very difficult to separate the causes of the one from those of the other conditions.

The *predisposing causes* of ulceration are chiefly found in those conditions that interfere in any way with the nutrition of a part. A feeble circulation, such as often exists in the lower limbs, the alæ of the nose, and in newly-formed or recently-cicatrized parts, tends to the formation of ulcers. As age advances, nutrition becoming impaired, and the circulation less active, slight causes suffice to disintegrate the structure of a part, and mal-nutrition, or loss of innervation from any cause, by lessening the vitality and resisting power of tissues, has a tendency to give rise to ulceration. Hence we so commonly see ulcers of the legs, in elderly people, more particularly amongst the poorer classes, arise from slight irritation or pressure. In the dogs that Magendie starved by feeding them on sugar, gum, or oil, and distilled water, ulceration of the cornea occurred. This must have been the result of simple mal-nutrition, rather than of inflammation.

Ulceration may be directly excited by the intensity of the inflammation at once destroying or disintegrating a part. By a severe mechanical injury, long-continued pressure, or the application of a chemical irritant, producing direct breach of surface. And, lastly, by the influence of certain specific diseases, which are accompanied by want of nutrition, as scurvy and some scrofulous affections, the peculiar character of which consists in the ready production of ulcerative action.

Ulceration may commence in several distinct ways on the cutaneous and mucous surfaces.

1st. There may be such a degree of acute local inflammation as rapidly gives rise to "molecular death" of the part. If the action be not a very

acute one, and the destruction of the tissues not very rapid or extensive, the disorganized matters become mixed with pus, and are discharged in the form of a dirty, brownish, puriform fluid. If the action be more violent than this, complete disintegration does not take place in the affected part, but shreds of the spoilt tissues continue attached for some time to the ulcerated surface, giving it a very ragged appearance. If the inflammation be of a more intense character, layers of disorganized tissue, constituting "sloughs," are formed, and remain in contact with the ulcerated surface, often covering it in completely, and invading with considerable rapidity the neighboring healthy structures. Thus, some of the forms of phagedenic, or sloughing ulcer, are constituted.

2d. Chronic inflammation may give rise to ulceration, by so interfering with the nutritive actions, that the balance of absorption and deposition is disturbed in favor of the former. The ulcerative effects of chronic inflammation are especially marked in parts that have been chronically congested; the congestion having given rise to such softening and loosening of tissue as facilitates materially ulcerative action.

3d. Ulceration sometimes commences in the crypts or follicles which open on the mucous surface, some modification of structure taking place in their epithelial linings, which leads to the formation of circular depressed ulcers, as may often be observed about the tonsils.

4th. A vesicle or pustule forming on the cutaneous surface, and shedding its contents, very commonly gives rise to an ulcer, as in Rupia and Pemphigus.

5th. Suppurative inflammation not unfrequently occurs in the subcutaneous or submucous cellular tissues, and by undermining and consequently destroying the vascularity of the skin and mucous membrane, and thus arresting its nutrition, gives rise to ulcer.

6th. In some specific cases, we find that ulceration is preceded by the formation of a morbid growth, tubercle, or tumor, in which inflammation and disintegration of tissue, and consequent lesion of substance occurs.

In whatever way ulceration commences, it presents three distinct stages: 1st, the period of extension, or of slough; 2d, the period of arrest, or of plastic deposit; and 3d, the period of granulation and of cicatrization.

1st. When the ulcer is spreading, there is always a circle of inflammation around it, as evinced by redness, heat, and a burning, throbbing pain; its edges are jagged, eroded, or sharp cut; its surface, which is more or less of a circular or oval shape, spreading pretty equally from one starting point, and being covered with a greyish or yellowish, soft, adherent slough. In ordinary cases this is thin and shreddy, but in some forms of ulceration it is soft, pultaceous, and elevated above the surrounding parts. There is either no discharge at all, or else a bloody, ill-conditioned fluid, hardly deserving the name of pus, drains from the surface.

2d. In the next stage of ulceration, that of arrest, the symptoms of inflammation diminish, and a layer of plastic matter is deposited in the tissues forming the base and sides of the ulcer. This not only serves to arrest or limit the further process of ulcerative action, but becomes the medium of its ultimate repair. The surface begins to clean, the grey adherent slough separating in fragments, and dissolving away in the discharge, which gradually loses its sanious tinge, assuming more the characters of healthy pus, though still very scanty in quantity. The surface continues flattened, its sensibility diminishes, and the edges are often elevated and indurated. In this stationary condition an ulcer may remain for many months; and it is that in which we commonly find chronic sores.

3d. The last stage, that of repair, is characterized by the formation of granulations, which may be looked upon as the turning-point in ulceration. Until granulations are formed, ulceration is a wasting process, or at most stationary;

so soon as they are formed, it becomes reparative. Instead of a tendency to increase, to erosion, and to concavity, we now have a disposition to contraction, to deposition, and to convexity of surface, which assumes a bright-red hue, of a vermilion or scarlet tinge, appearing to be studded with minute papillæ; the edges become rounded and smoothed down towards the surface, losing their sharp cut appearance, and the discharge assumes the characters of healthy pus.

We now proceed to study the changes that occur in an ulcer during the stage of repair, — the process of granulation, and of cicatrization.

1st. *As to granulations, their mode of formation, structure, and use.*

So soon as inflammation and extension of ulceration are checked, the surface of the ulcer, as has already been stated, becomes covered by a layer of plastic matter. This plastic layer, separating the ulcer from surrounding and adjacent tissues, forms a basis to it, from which the granulations, the organs of repair, spring up. Before this plastic basis can be deposited, it is necessary that the inflammation be reduced within those limits that are compatible with plastic effusion. So long as inflammatory action exceeds this limit around the edge or at the base of the ulcer, no lymph is effused. But so soon as this undue action is checked, lymph is thrown out, which becomes vascular by vessels shooting into it from below; and assumes a granular form from its deposition in papillæ, or granulations, which are consequently composed of exudative matter which has become vascularized in the way that has already been described. In the great majority of cases, granulations are only formed on surfaces exposed to the air and secreting pus; but they may be formed without exposure to the air or the formation of pus, as Hunter and Paget have shown to occur in some cases of fracture, the ends of the bones being covered by a distinct layer of florid granulations. That these granulations are in reality composed of lymph that has become vascular, is evident from the interesting fact observed by Hunter, and which every surgeon must have had repeated occasion to verify, both in wounds and compound fractures;—that a portion of bluish-white, semi-transparent lymph effused on the surface of the sore or denuded bone is seen to become vascularized, and to be converted into true granulations, in from twenty-four to forty-eight hours.

The microscope shows that granulations are composed of cells heaped up without much, if any, apparent order, and connected by but little intermediate substance. When single, they are colorless; when in clusters, they become ruddy. It is interesting to observe how these cells undergo different changes in different parts of the same ulcer.

Those situated at the base nearest the attached surface of the granulation, constituting its deeper layers, undergo development into filaments and fibro-cellular tissue. Those on the surface are either thrown off in a rudimentary form, or degenerate into pus-cells; whilst those at the edges become converted into epithelial scales. Thus we see the same action giving rise to exudation corpuscles, to pus, to epithelium, and to fibro-cellular tissue.

The *development of vessels in granulations* — a most wonderful and beautiful process, by which thousands may form in a day on a healthy granulating surface —is identical with their general development in lymph, which has already been described. A series of loops and arches being formed as outgrowths from neighboring vessels.

The sensibility of granulations varies considerably, being often greatest in those which spring from tissues that are naturally the least sensitive, as bone, for instance. No nerves have been traced in granulations, hence their apparent sensibility would appear to depend upon that of the subjacent inflamed tissues

The *characters* of granulations afford important indications to the surgeon as to the condition of the surface from which they spring, and the state of the patient's general health. Granulations indicative of a healthy local and constitutional condition, are small, florid, pointed, close-set, and bathed with healthy

pus; the use of which appears to be to cover and protect the tender surface with a soft lubricant coating, into which the granulations may sprout without being dried by the air, or readily damaged in any other way.

In a weak state of the sore, or of the constitution, the secretion of pus diminishes, and it loses its healthy character; the granulations become large, pale and flabby, appearing to be œdematous from infiltration of serum, and assuming a glassy or semi-transparent look, with a purplish hue. Occasionally hemorrhage takes place into them, and they become broken down and sloughy. If, whilst a sore is healthily granulating, morbid action is set up in it, or in the economy — as by the supervention of erysipelas, or fever — the granulations and pus-cells degenerate at once; the granulations becoming rapidly absorbed, and the surface of the sore assuming a greyish, sloughy look, and the formation of pus being arrested.

2d. *The healing process, or Cicatrization*, is that by which the ulcer closes and becomes covered by an integumental investment. Two distinct processes, though carried on simultaneously, are necessary for the accomplishment of this. These consist in the granulations assuming a healthy character, and covering themselves with new cuticle; and in the contraction of the surface of the sore.

The first change that takes place in an ulcer that is about to undergo the healing process, is, that the granulations become florid, and are bathed with healthy pus; the edges and surface of the sore then assume the same level — the granulations rising, and the edges subsiding. So long as there is any inequality in this respect, the process of cicatrization cannot go on. The granulations nearest the edges become smooth, cease to pour out pus, and become glazed over with a thin, whitish-blue pellicle, which is the first appearance of new skin, composed of granulation-cells developing into epithelium. As cicatrization advances, the part of the sore immediately inside this bluish-white line will be seen to be occupied by a red zone, which, in the course of four-and-twenty hours, becomes, in its turn, new epithelium, and appears to be the link between granulation and true cuticle.

At the same time that these changes are going on, contraction of the sore takes place. This would appear to be entirely a mechanical process, and not a vital action; and is owing to the conversion of the exudation-cells of the granulations into the filaments of cicatricial tissues, which being more closely packed, and becoming drier, occupy less space (Paget). This contraction commences as soon as the sore presents a tendency to cicatrize, and continues for a considerable time after this is completed.

Cicatrization advances with greatest rapidity around the edges of the sore; the centre taking the longest time to heal, in consequence of the activity of the process appearing to diminish the farther the new skin extends from the old tissues. Indeed, if the ulcer be large, there may not be sufficient force for the cicatrization of its centre. A sore of a circular shape usually takes a longer time to heal than an oval, elongated one; the reason appearing to be that the new skin is only formed at the edge, and never in the centre of an ulcer; unless it happen that islands of old skin are left there undestroyed, which serve as centres of cicatrization. It would appear to be necessary for the healing process, that granulations have some of the old textures to be modelled upon, the characters of which they then, and only then, appear to assume; receiving an impulse from the plastic force of the old tissues on which they are deposited, that causes their development into analogous structure.

The changes taking place in a cicatrix do not cease with its formation: two processes continuing for a very considerable length of time afterwards; viz. the gradual contraction and the development of the cicatricial tissue.

We have seen that granulations tend to contract during the healing of an ulcer, and that the diminution in surface thus produced, facilitates greatly its cicatrization. Hence a scar is never so large as the original sore. This con-

traction continues, however, and does not attain its maximum until long after the completion of cicatrization, often occasioning great puckering or deformity. The degree of contraction depends partly on the seat of the scar, but principally on the agent that produces the ulcer; if the scar be seated on a part where the skin is very tense, the contraction will be slight; if the skin be naturally loose, it will be considerable. The contraction that takes place in scars which result from burns, is greater than in those which occur from any other cause, often producing serious deformity and great distress to the patient. These results do not supervene in their fullest extent until after a lapse of some weeks or months from the infliction of the injury. This contraction would appear in some cases to be due, not only to the consolidation of the texture of the scar, but to the development in it of yellow elastic tissue.

Two great changes are wrought by time in the texture of a cicatrix; its tissue assimilating more and more to the normal structure of the part, and its deep attachments becoming more movable. When first a scar is formed, it is thin, reddish, or bluish and shining, being composed of imperfectly-developed filamentous tissue, covered by a thin epithelial layer. As it becomes older, it assumes a dead-white color, and becomes depressed, and gradually, but slowly, many years being required for the change, it "wears out;" that is to say, its structure more closely resembles that of the texture of the part on which it is seated. It never, however, becomes developed into true skin, as neither hair, nor sebaceous or sudoriferous glands form in it.

In structure cicatrices are composed of a fibro-cellular tissue, rather sparingly supplied with blood-vessels, and covered by a thin epithelial covering, usually smooth and glistening, but sometimes nodulated and rugose. The sensibility of the cicatrix itself is lower than that of the skin generally, but it will usually be found that the edges of the integument, when in contact with the cicatrix, are more highly sensitive than are the integuments on other parts of the body. When tough and irregular cicatricial bands, or "*bridles*," stretch across a part, it will usually be found that they are devoid of sensibility.

Coincident with these changes, the scar loosens its deep attachments, so that it can be moved more freely upon subjacent parts. It is a long time before the scar attains the vitality of the older structures, if ever it does so completely; and the larger it is, the less its power will usually be. Under the influence of scurvy or syphilis, an old scar is apt to open up again; so also if a fresh ulcer is formed on the old cicatrix, it will take a longer time to heal than the original one.

The *diagnosis of ulcers* is readily made when seated on the skin, where no art is required to recognize a sore. On the mucous surfaces, however, it is not always easy to do so; enlarged follicles and crypts, or aphthæ, being constantly confounded with ulcers. The difficulty here proceeds from the circumstance that muco-pus may be poured out from a simply inflamed surface, or from one in which the abraded epithelium and open crypts are mistaken for ulcers.

In the *local treatment* of ulcers, the following points should be particularly attended to:—1stly. To subdue inflammation; for until this be done no proper reparative action can go on. This is accomplished by the ordinary local antiphlogistic treatment. 2dly. Position and rest are essential, in order that congestion or determination of blood may not take place. 3dly. Proper local applications adapted to the nature of the case, of an emollient, sedative, astringent, or stimulating character, must be employed frequently, conjoined with pressure upon, or support to, the weakened vessels of the part.

The *constitutional treatment* must be carefully attended to. Unless this be done, the best regulated local plan may be employed in vain. Attention to the digestive organs, and improvement of the constitution, if it be strumous or syphilitic, will do more in these cases than any other means can accomplish.

GANGRENOUS INFLAMMATION.

Gangrene may result either from the *intensity* or from the *specific character* of an inflammation.

The intensity of the inflammation may be so great as to kill the part directly, however healthy its texture, or sound the constitution of the patient may be. More commonly, however, it is not so much the actual as the relative intensity of the inflammation that destroys the part; there being some debility, local or constitutional, by which its resisting or preservative power is lessened. It is this occurrence of inflammation in a part or system in which the vital force is defective, that is especially apt to result in gangrene; and it is remarkable to observe what slight injuries will induce gangrenous inflammation under these circumstances, especially in the residents in towns and in those who are debilitated. The greater the general and local debility, the greater will be the liability to gangrene. The nature of the tissue exercises, however, considerable influence; thus, with a moderate amount of inflammation, some tissues, when inflamed, very readily run into gangrene, the cellular membrane especially being apt to do so; whilst others, as the proper tissue of glands and organs, are seldom so affected.

The specific character of the inflammation influences greatly the disposition to gangrene; some forms, as the carbuncular, invariably resulting in the loss of vitality of the part. In some states of the constitution, the blood appearing to be diseased, there is a great liability to gangrene.

When a part has been violently inflamed in consequence of injury, or some such cause, we look upon gangrene as impending, if we find that the redness becomes of a dusky or purplish hue; that bullæ filled with dark fluid rise upon the surface; that the swelling, at first hard, tense, and brawny, becomes of a pulpy or doughy character; that the pain is of a dull, heavy, or burning kind; and that the temperature of the part, at first greatly increased, gradually sinks. We know that gangrene has taken place when there is total loss of the sensibility of the part even to pricking or pinching; that the motion of the part itself ceases; that its color changes to a peculiar mottled, purplish-red, or greenish-black hue, unlike anything else in the body; that the temperature falls to a level with that of surrounding parts; or if the surface affected be extensive, may even feel colder, owing to evaporation from it. There is likewise an odor evolved differing from that of ordinary decomposition, and evidently depending upon gaseous exhalations from the part that has lost its vitality.

These signs constitute *moist* or *acute* gangrene, occurring as the result of inflammation. Death and putrefaction are simultaneous in this case, the putrefaction being evidently the result of changes effected in the tissue by the inflammatory act, and not by *post-mortem* chemical decomposition, the part being decomposed at the same time that it is killed. The extent of tissue affected may vary from a mere spot to the implication of the greater portion of a limb, and the gangrene appears to be finally arrested by the inflammation expending its force as it radiates from the centre, and reaching a part where there is sufficient vitality for adhesive inflammation to be set up.

The constitutional symptoms, always of a low type, vary according to circumstances. If the blood be healthy, and the constitution sound, the gangrene occurring as the consequence of severe injury, the symptoms will present the ordinary character of inflammatory fever, though even in these cases there is a great tendency to asthenia. If the constitution be broken, or the blood in a diseased state, the constitutional symptoms will rapidly run into the irritative form.

The progress of gangrenous inflammation would be indefinite were it not

arrested by the adhesive process which limits it, just as it bounds the suppurative inflammation. So soon as the gangrene reaches a part, the vitality of which is too active to be destroyed by the inflammatory action; and where inflammation consequently takes on that form, which it always does in healthy tissues—the adhesive; or, if the inflammation, gradually lessening in severity as it extends from its gangrenous centre, subsides to that degree which is compatible with the formation of lymph, the *line of demarcation*, as it is termed, is formed. This line is a kind of barrier or septum of plastic matter, poured out into the interstices of the healthy tissues at their extreme limits next the gangrene; the line, indeed, along which the dead and living parts touch. It extends along the whole depth of the gangrene, completely surrounding it on all its attached sides. The inflammation does not cease abruptly in this line, but fades away in the healthy parts beyond it.

So soon as the gangrene is arrested, nature endeavors to throw off the spoilt part. This is effected by a process of ulceration, extending through the line of demarcation, and loosening the slough by the absorption of that layer of living tissues which lies next to it. This line of ulceration is termed *the line of separation*, and extends itself along the extreme margin of the living tissues; the dead parts being removed solely by actions going on in the contiguous living structures, except where they may be partially disintegrated by the pus that is thrown out.

This process of separation commences at the edge of the slough, which gradually loosens, and slowly extends downwards to the whole depth of the gangrene; if this affect the entire thickness of a limb, the ulceration will find its way completely across it. If the slough be more superficial, the ulcerative action passes underneath it, detaching it gradually. The line of separation is usually oblique, the soft parts being first divided, and the hard tissues then ulcerated through, until the ligamentous, or osseous structures are reached, which are slowly acted upon by it. This action is most rapid in the soft parts, and in young subjects.

After the separation of the gangrenous part, a more or less ragged, irregular ulcerated surface is left, which, if not too extensive, will undergo ordinary cicatrization. As ulceration extends across the limb, the largest arteries and veins are cut through by it, without hemorrhage resulting, owing to a mass of plastic matter being poured out in their interior, and blocking them up from the line of separation to the nearest large collateral branch above it. The period required for the detachment of gangrenous parts varies according to their extent. Small sloughs may be detached in a few days, whilst many weeks are required for the separation of a limb.

In the *treatment* of gangrenous inflammation, antiphlogistic remedies must be very sparingly used, the patient's condition being usually not of such a nature as to bear lowering. It is very easy to knock down the inflammation by energetic measures; but, at the same time, the reparative power of the system is destroyed, and the patient may not be able to rally. Inflammatory fever, however high it may be in the early stages, rapidly sinks after gangrene has set in, symptoms of an asthenic, or an irritative type, ensuing. Hence it is only before the occurrence, and during the spread of gangrene, that antiphlogistic remedies can be employed; for when once gangrene has ceased to extend, however high the action may have been that accompanied its progress, all the powers of the constitution will be required to maintain the process of separation of the sloughs, if they be extensive and deep.

Venesection is never required in any form of gangrenous inflammation. When blood requires to be taken, local blood-letting should be had recourse to as a preventive means. And, in this way, when conjoined with measures for the relief of tension, and consequently of that strangulation of the tissues which is such a fertile cause of gangrene, in some forms of inflammation, it

becomes an extremely important adjunct to the treatment. In these cases, free incisions into the inflamed and tense parts, by which the vessels are relieved of the blood, and the tissues of effused fluids, will often prevent gangrene. This is more especially the case when loose cellular tissue, as that of the penis or scrotum is inflamed, or indeed in any part in which much tension is conjoined with the inflammation. In some forms of inflammatory sloughing, nature relieves the part by free hemorrhage, as from the dorsal artery, in cases of acute gangrene of the penis, and it is not until this has taken place that the gangrenous action becomes arrested. In this way, also, irritant effusions and infiltrations are discharged, and thus one cause of sloughing removed. Punctures are not sufficient for this purpose, but free incisions from two to three inches long should be made, which by gaping widely allow the escape of blood and other fluids, and thus effectually relieve tension. Mild local antiphlogistic treatment of an ordinary character is likewise required. When the gangrene has been arrested, the fœtor of the sloughs must be diminished by antiseptic applications, such as the solutions of the chlorides, charcoal, and yeast poultices. The separation of the sloughs should be left as much as possible to nature, which is always fully able to accomplish this, if the patient's strength can be kept up. Any attempt to hasten this process only irritates the parts, and causes the gangrene to spread when it might otherwise have been arrested. The vitality of the tissues in the proximity of, and above the line of separation, is very low, and may readily be destroyed by any fresh action set up in them, there being always a danger of exciting inflammation to such a degree as to exceed that which is necessary for the adhesive, and to cause it to run into the gangrenous form. Hence no attempt should be made to pull away sloughs not already separated, nor should stimulants be applied to the living tissues. It matters little as to what is done to parts already dead, which, when loosened, may be cut away, but we must not meddle with those that are living. Hemorrhage seldom occurs before the separation of the sloughs, but there is always danger of its happening during that process. If it occur, pressure or the actual cautery, will be found the best means to arrest it. And if these fail, ligature of the artery higher up, or amputation, when practicable, might be required.

The parts that are already gangrenous should be enveloped in lint soaked in the chlorides of zinc, or lime, or in creosote, or dusted with charcoal powder. No poultices should be applied if the sloughs are large, heat and moisture hastening their decomposition; but if small, yeast, carrot, or charcoal poultices may be advantageously applied.

Parts that are quite dead, but that do not readily separate, such as tendons, ligaments, and bones, may be cut through with scissors, pliers, or saws, and thus many weeks or months saved in their separation. It may occasionally be necessary in doing this to encroach on the living tissues; this should be done as carefully as possible, for reasons already stated. They do not bleed much, owning to their infiltration with lymph.

The line of separation should be dressed with water-dressing, or with some mild detergent lotion or ointment, in order to keep the surface clean, and free from absorption of gangrenous matters. If sloughs are not readily separated, the balsam of Peru, either pure, or diluted with yolk of egg, or very dilute nitric acid, and opiate lotions, are the most useful applications. After the separation of the sloughs the ulcerated surface must be treated on general principles.

The constitutional treatment of gangrenous inflammation requires to be conducted upon the principles that guide us in the management of the asthenic and irritative forms of inflammatory fever;—by attention to hygienic measures, and the moderate employment of antiphlogistic remedies in the early stages; by support of the system, by means of light tonics, nourishment, and stimulants, as the disease assumes an asthenic form; and by the administration of opiates as it sinks into the irritative type.

DIVISION SECOND.

SURGICAL INJURIES.

CHAPTER V.

EFFECTS OF INJURY.

THE effects of an injury, if at all severe, are twofold, constitutional and local. The constitutional effects are *immediate* and *remote*.

The *immediate* constitutional effects, or *shock*, consist in a disturbance of the functions of the circulatory, respiratory, and nervous systems, the harmony of action of the great organs of the body becoming disarranged. On the receipt of a severe injury the sufferer becomes cold, faint, and trembling; the pulse is small and fluttering; there is great mental depression and disquietude; the disturbed state of mind revealing itself in the countenance, and in incoherence of speech and thought; the surface becomes covered by a cold sweat; there is nausea, perhaps vomiting, and relaxation of the sphincters. This condition lasts for a variable period, its duration depending on the severity of the injury, and on the nervous susceptibility of the patient. In extreme cases, the depression of power characterizing shock may be so great as to terminate in death. In the great majority of instances, however, reaction comes on, and the disturbed balance in the system is gradually restored. Not unfrequently the reaction runs beyond the limits necessary for this, and a febrile state is induced.

Is this state the result of fear and nervous susceptibility? or is it occasioned directly by the physical lesion? In many cases, doubtless, the effect is entirely mental. Thus persons have been frightened to death without any local mischief. That there is great difference in the mental fortitude of individuals is notorious; some suffering excessive shock from the mere apprehension of injury, whilst others may be the subjects of the severest injury, and show but slight sign of suffering. If the injury be sudden and unexpected, the shock is usually greater. When the feelings are roused, as in the heat of action, injuries often pass unnoticed by those who receive them. Hence it is evident, that the state of mind at the time of the receipt of the injury materially influences its immediate effect on the constitution. There can be little doubt, however, that different individuals manifest very different degrees of susceptibility to pain, some having more acute sensations than others. Instances of this kind must have fallen under the observation of every surgeon.

The sudden occurrence of a severe injury will induce a physical impression independently of any mental emotion. Thus if a limb of one of the lower animals be suddenly crushed by the blow of a hammer, the force and frequency of the heart's action immediately becomes considerably lessened. Here there can be no mental impression. So in man, it is found that the severity and the continuance of the shock are usually proportionate to the severity of the injury. The surgeon not unfrequently employs this fact as an accessory means of diagnosis. Thus, if a man break his leg, and at the same time strike his abdomen,

and the shock be very serious, and long-continued, without sign of rallying, the probability is that some severe injury has been inflicted upon an internal organ; injury of the viscera occasioning greater severity and longer continuance of shock than a wound of a less vital part.

The *remote* effects of shock give rise to serious constitutional disturbance, as has been pointed out by Hodgkin and James, which often do not manifest themselves for weeks or months after the infliction of the injury. Some change appears to be induced in the condition of the blood, or in the action of the nervous system, that is incompatible with health; severe febrile diseases, usually of a low form, supervening. Perhaps, as Hodgkin supposes, the part locally injured becomes incapable of proper nutritive action, and thus a morbid poison results, in consequence of some peculiar combination of the chemical elements of the part, by which the whole system is influenced. Be this as it may, the fact remains certain, that constitutional disturbance may continue for, or supervene, at a considerable time after the infliction of a local injury.

The *direct local* effects of injury comprise *contusions*, *wounds* of all kinds, *fractures*, and *dislocations:* these we shall immediately proceed to consider.

The *remote local* consequences of injury are not so obvious. But there can be little doubt that many structural diseases owe their origin to this cause. The nutrition of a part may be modified to such an extent by a blow or wound inflicted upon it, as to occasion those alterations in structure which constitute true organic disease. Thus we occasionally find, on death resulting some months after a severe injury, that extensive local mischief, usually of an inflammatory character, is disclosed, which has evidently been going on in an insidious manner from the time of the accident.

In other cases again, a blow may give rise to severe and long-continued neuralgic pains in a part, or it may be the direct occasioning cause of structural disease in bones, joints, or blood-vessels; and, lastly, the origin of many cases of cancer can be distinctly referred to external violence.

Treatment of Shock.—If the disturbance be chiefly of a mental character, the patient will usually rally speedily by being spoken to in a kind and cheering manner, or by having a little wine and water, or ammonia, administered. If the shock be of a more severe character, and be the result of considerable injury, the patient should be laid in the recumbent position, and the injured part arranged as comfortably as possible; he should be wrapt up in warm blankets, hot bottles should be applied to the feet, and friction to the hands and surface; a little warm tea, wine, or spirit, and water, may be administered, provided the insensibility be not complete; if so, it should not be given, as the fluid might then find its way into the larynx. Under these circumstances, ammonia should be applied to the nostrils, and a stimulating enema administered. When there is much pain associated with the shock, a few drops of laudanum may advantageously be given. By treatment such as this, the energies of the nervous and vascular systems are gradually restored, and then reaction speedily comes on.

A question of considerable importance frequently occurs to the surgeon in these cases, viz., whether an operation should be performed during the continuance of shock. As a general rule, it certainly should be deferred until reaction comes on, as the additional injury inflicted by the operation would increase the depression under which the patient is suffering. In some cases, however, the presence of a crushed limb appears to prolong the shock, and thus prevents the patient rallying, notwithstanding the administration of stimulants. Under these circumstances, the surgeon would be justified in operating before reaction came on. Here the administration of chloroform is extremely beneficial by preventing the pain and dread of the operation from still further depressing the vital energies. In these cases of long-continued shock, great care is required in ascertaining that there is no internal injury

giving rise to the depression, but that the shock is really dependent upon the mangled limb.

After the immediate effects of the shock have entirely passed away, we must adopt means to prevent the remote consequences. With this view — if the patient can bear it — blood-letting is of essential service, and, I think, far too much neglected at the present day. In addition to this, the patient's diet and habits of life should be carefully regulated, over-stimulation being especially avoided; his bowels should be kept freely opened, and his general health attended to. After the immediate effects of shock have gone off, the reaction which ensues may not pass the limits of health; but if the injury be severe from its extent or from the implication of important parts, the local inflammation, which is necessary for its repair, gives rise to a general febrile state. This inflammatory fever assumes one or other of the types characterizing that which accompanies ordinary inflammation, and requires to be treated on the principles that guide us in the management of that affection.

Traumatic delirium not unfrequently occurs in cases of severe injury in individuals with an irritable nervous system; particularly in those who had been drinking freely before, or were intoxicated at the time of the accident. It usually comes on about the third or fourth day, but not unfrequently earlier than this; and most commonly declares itself during the night. This disease presents two distinct types — the one inflammatory, the other irritative.

In *inflammatory traumatic delirium* there is a quick and bounding pulse, hot skin and head, flushed cheeks, glistening eyes, much thirst, and high febrile action generally. The delirium is usually furious; the patient, shouting, singing, tossing himself about the bed, and moving the injured limb regardless of pain. The treatment of this form of the disease is strictly antiphlogistic. Bleeding from the arm, with leeches and ice to the head, purging, and low diet, will subdue it; but in many cases it is speedily fatal.

The *irritative, or nervous delirium*, usually occurs in persons of a broken constitution; and closely resembles ordinary delirium tremens; sometimes it is preceded by a fit of an epileptic character. In this form of the disease the pulse is quick, small, and irritable; the pupils dilated; the surface cool; the countenance pale, with an anxious, haggard expression, and bedewed with a clammy sweat. The tongue is white, and there is sometimes tremor of it and of the hands; but this by no means invariably occurs. The delirium is usually of a muttering and suspecting character; the patient is often harassed by spectral illusions, but will answer rationally when spoken to. This form of disease is sometimes very rapidly fatal. I have known it destroy life in cases of simple fracture in less than twelve hours.

The *treatment* of irritative traumatic delirium consists essentially in the administration of opium until sleep is procured, or the pupil becomes contracted. For this purpose, large quantities are frequently required; and the drug should be given in full doses, and repeated every second or third hour.

If there be much depression, it will usually be expedient to administer the opiate in porter, or in that stimulant to which the patient — if a drunkard — has habituated himself. The administration of the opiate should be preceded by a free purge and an aperient enema, so that all source of irritation may be removed from the intestinal canal. A strait-waistcoat is commonly necessary in all cases of traumatic delirium, in order to prevent the patient injuring the wounded part.

After sleep has been induced, the quantity of the opiate must be lessened; but it will be found necessary to continue it for some time, as there will be a tendency to the recurrence of the delirium at night.

These two forms of traumatic delirium, the inflammatory and the irritative, are often found more or less conjoined; a modification of the treatment then becomes requisite—the surgeon depleting with one hand, and allaying irritation by opiates and giving support with the other.

CHAPTER VI.

INJURIES OF SOFT PARTS.

Contusion. — In a contusion the skin is unbroken, but there is always some laceration of the subcutaneous structures. Indeed, great disorganization of these occasionally takes place, though the skin continues entire, owing to its greater elasticity and toughness. Hence a contusion may be looked upon as being a subcutaneous lacerated wound.

Contusions may result from direct pressure — as, when a part is forcibly squeezed; from a direct blow, usually by a hard, blunt body; or, from an indirect blow, as when the hip-joint is contused by a person falling on his feet from a height.

Compression of the parts injured is always necessary to constitute a contusion. This compression may occur between the force on one side, and a bone as the resisting medium on the other; or the part injured may be compressed and contused between two forces in action—as when the hand is caught between two wheels revolving; or between a force in action and a passive medium — as by a wheel passing over the limb and crushing it against the ground.

Contusions are of various degrees; they may be arranged as follows:—1stly, of the skin simply; 2dly, with extravasation into the cellular tissue; 3dly, with subcutaneous laceration of the soft parts; and 4thly, with subcutaneous disorganization of the soft and hard parts.

In all cases extravasation of blood is the chief characteristic of contusion. In the first degree the blood is merely effused into the skin, producing ecchymosis or bruise; the color of which varies from purplish-red to greenish-brown; being dependent upon changes that take place in the extravasated blood as it undergoes absorption.

In the second degree, a bag of blood can often be felt fluid and fluctuating under the skin, in which state it may remain for weeks or even months without undergoing any material change, provided it be excluded from the air. In other cases it gradually becomes absorbed; or, if it communicate with the air, the bag being opened in any way, it may undergo disintegration, suppuration taking place within or around it, and the clots discharging through an abscess. In some cases it would appear from the observations of P. Hewett and of Paget, that the clot resulting from extravasated blood may become organized and finally penetrated by blood-vessels. The French pathologists have described the formation of a cyst containing serous fluid in the site of the extravasated blood. These cysts are composed of a fibrous structure, but without cells; they have no distinct lining membrane, and in their interior serous or grumous fluid, composed of disintegrated blood, is found. In other cases the serous or fluid parts are absorbed, and the fibrinous matters forming cheesy concretions are left behind. Lastly, extravasated blood may give rise to a sanguinous tumor, Hematoma, the blood — continuing for years fluid, but still not unchanged — becoming darker, treacly, and more or less disintegrated, being intermixed with various products of inflammation.

In the third and fourth degrees of contusion, the laceration and disorganization of structures usually lead to fatal internal hemorrhage, to sloughing and suppuration, or to rapid gangrene of the parts.

The *diagnosis* of contusions is not always easy. The minor degrees may be mistaken for incipient gangrene; the discoloration not being very dissimilar, but that the part, when simply contused, preserves its temperature and vitality. In some cases the extravasated blood has a hard, circumscribed border, and is

soft in the centre, thus resembling somewhat a depression in the subjacent bone. This is especially the case in some bruises about the scalp.

The diagnosis of old cases of extravasation, leading to Hematoma, from abscess or malignant disease, is not always easily made by tactile examination only, but the history of the case, exploration with a grooved needle, and examination of the contents of the tumor under the microscope, will always clear up any doubt that may exist.

Treatment.—In the two first degrees of contusion our great object should be to excite, as speedily as possible, the absorption of the extravasated blood. Here cold applications are of especial service; lotions composed of one part of spirits of wine or of tincture of arnica to eight or ten of water should be constantly applied. Of the value of arnica in these cases I entertain no doubt; I have employed it largely in the most extensive extravasations, and have rapidly promoted their absorption by its use. Leeches — so commonly used in these cases — should not be applied to a bruised part, they cannot remove the blood that has already been extravasated, and often set up great irritation, that leads to its suppuration. The bag of blood should never be opened, however soft and fluctuating it may feel, so long as there is any chance of procuring its absorption by discutient remedies; but if signs of inflammation occur around it, the parts becoming red, hot, and painfully throbbing, free incisions should at once be made, the blood — already disorganized and mixed with pus — be discharged, and the cavity allowed to granulate. Purging and general antiphlogistic treatment will often be found of use in promoting absorption of the extravasation.

In the third and fourth degrees of contusion it is useless to attempt to save the life of the injured part. Here poultices must be applied to hasten suppuration and the separation of the sloughs; the ulcer that results being treated on general principles. In the worst cases of contusion, where the structures of the limb are disorganized, amputation is the sole resource.

Contusions of internal organs are always of a very serious character, and require special treatment according to the part that is affected. and the extent of its injury.

WOUNDS.

A *wound* may be defined to be a solution of continuity suddenly produced by the incision, rupture, or fracture of a part.

Surgeons universally divide wounds into *incised, lacerated, contused, punctured,* and *poisoned.*

Incised wounds may vary in extent, from a simple superficial cut to the incisions required in the amputation at the hip-joint. Incised wounds are usually open, communicating freely with the air; occasionally, however, when made by the surgeon they are sub-cutaneous, only communicating externally by a small puncture; they may be simple, merely implicating integument and muscle, or, complicated with injury of the larger vessels and nerves, or of important organs. In all cases they give rise to three symptoms; viz. *pain, hemorrhage,* and *separation* of their *sides.*

The *pain* in an incised wound is usually of a burning, cutting, or smarting character. Dr. J. Johnson compared his own sensations to the pain experienced by a stream of melted lead falling upon the part. Much depends, however, on the extent and the situation of the wound; and also whether the cut is made from the cutaneous surface, inwards, or from within outwards; being greater in the former than in the latter case, owing to the section of the nerves being made from the branches towards the trunk. When the cut is from within outwards, the trunks being first divided, the branches are paralyzed, and do not feel the subsequent incisions.

The amount of *hemorrhage* necessarily depends upon the vascularity of the

part, as well as on the size of the wound. The proximity of the part wounded to the centre of the circulation, or to a large vessel, also influences this very considerably—different parts of the same tissue bleeding with different degrees of facility. Thus, the skin of the face pours out more blood when cut than that of the leg. The same parts will, under different states of irritation, pour out different quantities of blood. Thus the tonsils have bled, after their excision, to such an extent as to occasion death, though usually but a few drops are lost.

The *separation of the lips* of the wound depends on their tension, and the position of the part, as well as on the elasticity and vital contractility of the tissues. It is greatest in those parts that are naturally most elastic, or that possess the greatest degree of tonicity; thus, the muscles, when cut, will retract to a distance of some inches; so also the arteries and skin gape widely when divided; whereas in the ligaments or bones no retraction takes place.

Incised wounds may unite in the five following ways: — 1stly, by the direct growing together of their opposed surfaces; 2dly, by scabbing; 3dly, by the opposite surfaces uniting through the medium of coagulable lymph; 4thly, by granulations springing up from the sides and bottom, and covering themselves with an epithelial coating; and, 5thly, by the growing together of two granulating surfaces.

1st. The *direct growing together of opposite surfaces* was termed by Hunter "*union by the first-intention*," though this term is not employed in this acceptation by modern surgeons, most of whom extend it to the union by adhesive inflammation. When wounds unite in this way, it is by the simple and direct coalescence of the opposed surfaces; and not, as Hunter had supposed, by the interposition of a layer of effused blood becoming the bond of union; or, as others have imagined, by lymph being poured out, which unites the opposed surfaces. Dr. Macartney, who pointed out the error of these doctrines, has shown that in this kind of union there is no intervention of blood or of lymph; the process consisting essentially in clean-cut parts, laid in apposition, uniting and growing together directly in the course of a few hours, without inflammation of any of its products being required to effect the union; hence he termed it "*immediate union.*"

The conditions necessary for direct union appear to be the perfect coaptation of the cut surfaces — a healthy constitution and the absence of all inflammatory action. It is not often in surgical practice that such a simple and direct result can be obtained, though in some of the plastic operations about the face, we not uncommonly succeed in securing it. After some of the larger operations, also, this kind of union occasionally takes place. Thus Paget records a case of amputation of the breast, in which the flaps contracted immediate and direct union with the subjacent parts; and on the patient dying at the end of three weeks of erysipelas, the union was so perfect that it was impossible to discover by microscopical examination that any inflammation had existed, or exudative matter been poured out. In some flap operations, the surgeon may be successful in attaining union by this means. Thus, in amputations of the thigh and arm, we occasionally find that nearly the whole, or a considerable portion of the flaps, are united together at the expiration of about eight and forty hours.

2d. *Healing by scabbing* consists in the direct adhesion of the lower part and sides of a wound under a crust of dried blood, hair, etc. which forms an air-tight covering. The absence of inflammation is necessary for healing by scabbing; if inflammatory effusion occur, the scab will be thrown off, and air getting admitted, an ulcer forms, upon which granulations will spring up. This kind of union is extremely rare in man, owing to the readiness with which inflammation is excited; but is common in the lower animals, inflammation being not so readily induced in them. This natural process is sometimes

imitated by the surgeon closing a wound with a piece of lint steeped in blood or in collodion, under which union takes place.

Analogous to healing by scabbing is the process of cure in subcutaneous wounds, as in Tenotomy; in these, union takes place without any inflammation, though this is sometimes excited by the injury; the reparative material, "nucleated blastema," not being an inflammatory product.

3d. *Union by the adhesive inflammation*, the "*union by the first-intention*" of modern surgeons, or "*primary adhesion*," as it is termed by Paget, consisting in the effusion of lymph between the opposed surfaces, is more frequently obtained than the direct union. In order that it should take place, it is of great importance that no blood be interposed between the sides of the incision; hence it is facilitated by all oozing being allowed to cease, and by the surfaces being allowed to become glazed by the exudation of lymph for some hours before they are brought in contact. If any blood be interposed, it acts as a barrier to the cohesion of the opposite layers of plastic matter, invariably becoming disintegrated, breaking down, and being washed away by the suppuration excited by its presence; hence in the dressing of surgical wounds, such as stumps after amputation, in which it is desirable to procure union by adhesive inflammation, the cut surfaces should not be brought together for a few hours, until all oozing of blood has ceased, and the fibrinous layer thrown out.

The union by adhesive inflammation in an incised wound takes place in the following manner: After all hemorrhage has ceased, the surface becomes "glazed," being covered with a film of the fibrine of the liquor sanguinis, with which a large quantity of white corpuscles are found intermixed, a sero-sanguinolent fluid draining away. This layer of fibrine rapidly becomes thickened by the deposit of exudative matter, and ultimately becomes vascular, undergoing development into fibro-cellular tissue, which constitutes the bond of union, its exposed surface becoming gradually covered by an epithelial layer, as has already been described in speaking of the development of lymph and its cicatrization. The adhesive layer forms with varying rapidity on different surfaces; thus, in a stump, after amputation, it will be found that the muscles, fasciæ, and cellular tissue are covered with fibrine in the course of a few hours; it is not until about the third or fourth day that the subcutaneous fat becomes coated in the same way; and eight or ten days elapse before the adhesive lymph is thrown out upon the cut surface of the bone; and here it shows itself first on the medullary canal, afterwards on the cancellous texture, and lastly upon the hard bone.

For the production and organization of this lymph a certain amount of inflammation is absolutely necessary, but the inflammation must be confined within proper limits. If too violent, the adhesive may pass into the suppurative inflammation; and if too long-continued, its development may be interfered with; for though inflammation be necessary for the formation of the bond of union, none is required for its organization, or its ultimate development into fibro-cellular tissue.

4th. In those cases in which union by direct cohesion, or by the adhesive inflammation fails, either by the interposition of blood, by the excitation of undue inflammation, by the wound being left open to the air, or by any other disturbing cause, granulations are thrown out, and union by "*the second-intention*," as it is termed, occurs; and one may often see in the same incised wound one portion healed by direct union, another part by the adhesive inflammation, and the remainder by granulation. Union by granulation, or the second-intention, has already been described when speaking of the repair of ulcers, with which it is identical (p. 101). A layer of plastic exudation is deposited, which gradually increases in thickness, becoming vascular: accumulating in masses of pointed and ruddy granulations, throwing off pus and effete corpuscles from

its surface, and developing in the deeper parts into fibro-cellular tissue, whilst the more superficial portion undergoes epithelial transformation.

5th. It not unfrequently happens that although granulations have sprung up, union between the opposed surfaces has not taken place. We must endeavor to accomplish this, by bringing the granulating sides of the wound together, when they will cohere, thus constituting union by "secondary adhesion." In some amputations, and in many plastic operations, cases of hare-lip, cleft-palate, &c., this mode of union is occasionally established.

Management of Incised Wounds.—In the treatment of an incised wound, we must always endeavor to procure union directly or by adhesive inflammation between a portion, if not the whole, of the surfaces; if union in this way be obtained, we save the patient much time and trouble.

The probability of procuring adhesive union depends greatly upon the constitution of the patient, as well as on the management of the wound. The sounder the constitution, the more readily will union by the first-intention take place; and in all cases, it is disposed to by the removal of all sources of irritation from the system. Thus in those operations, the plastic, for instance, in which it is necessary that the union be as direct as possible, the constitution of the patient should be prepared, by his being kept for some time previously upon a nourishing but unstimulating diet, chiefly consisting of milk and light animal food, having regular exercise, and his bowels acted on by saline aperients: we should also look specially to the state of the digestive and urinary organs, and remove any source of irritation in connexion with them. In cases of accidental wound, if we wish to secure union by the first-intention, we must purge the patient, keep him quiet, and employ a moderately antiphlogistic regimen, avoiding especially all stimulants, which have a great tendency to interfere with this desirable result. It must be borne in mind, that the great object is to limit inflammation; if this be carried beyond what is necessary for plastic effusion, suppurative action will certainly occur. With regard to local antiphlogistic treatment, nothing is required beyond simplicity of dressing, and keeping the part cool by means of wet lint, or, if the wound be very extensive, and inflammatory action threaten to run high, by irrigation (Fig. 45).

There are three great indications in the local management of an incised wound.

The first is the *arrest of hemorrhage.* If the bleeding be general from the surface, it may be stopped by position, by coaptation of the sides of the wound, and by the application of cold and styptics. If it be of an arterial character, ligatures will be required to the bleeding points.

The next indication consists in *the removal of foreign bodies* of all kinds; such as dirt, pieces of stone, glass, &c., including coagulated blood from between the lips of the wound. In doing this, care should be taken not to wipe the wound too roughly; a piece of soft lint, a triangular bit of sponge, or a stream of cold water poured over the surface, should be the means employed.

The next and most important indication to fulfil, is *the coaptation of the opposed surfaces* as accurately as possible. This can only be maintained by attention to position, and by the application of sutures, plaster, and bandages.

As a general rule, the sides should not be brought together until all hemorrhage has ceased. If, however, there be but slight oozing, this may be arrested by the approximation of the surfaces. If the wound be extensive, it may be advantageous to wait for a few hours, until its sides are glazed over by a layer of fibrine. The parts should now be brought gently in contact, due attention being paid to relaxing them as much as possible, by position, so that there may be no gaping of the lips, or tension on the sides of the wound. They must be kept in position by sutures, plasters and bandages.

Sutures are commonly employed when there is more tendency to gaping than can be overcome by position or plasters. The material that is generally used

for this purpose is well-waxed dentist's or twisted silk of various degrees of fineness, introduced by means of a curved needle. Sometimes silver wire is employed. In wounds of the limbs, especially in those cases in which some traction may be expected, the suture should be composed of soft thick silk-twist; whilst in those cases in which it is of importance that as little deformity as possible be left, it should consist of the finest silk or thread that is compatible with the requisite strength.

Sutures may be of various kinds: the *interrupted*, consisting of a number of single stitches, applied at distances varying from half an inch to an inch and a half, is the one most commonly had recourse to in all the cases involving the integument. In applying this suture the needle should never be carried deeper than the integumental structure, except in some of the parts about the face, such as the lips and eyelids. The suture should be tied by means of the reef-knot, and the ends be cut short.

The *continuous* suture, never used on the cutaneous surface, is principally employed in incised wounds of the intestines.

The *quilled* suture is applied in cases, as in rupture of the perineum, in which the sides of a deep wound are required to be brought into contact throughout. It consists of a double interrupted suture passed deeply, and tied tightly over pieces of elastic bougie, laid parallel to, and at the distance of half an inch from the edges of the wound.

The *beaded* suture is rarely employed at the present day: in it the knot is made over a large bead, or a split shot, strung upon either side of the suture, which thus diffuses the pressure over a greater extent of surface.

The *twisted* or figure of 8 suture is very commonly employed in surgery; it consists in the introduction of a slender pin, made of soft iron, with a steel point, across the lips of the wound, and the application of soft silk-twist over this in the manner of a figure of 8, care being taken not to draw it too tight, or to compress the soft parts between the needle and suture, lest sloughing result.

Sutures, of whatever kind, act as irritants along the tract through which they are applied, hence they should always be withdrawn as soon as they have accomplished their object — that of procuring union of the opposed surfaces. Every minute that they are left in beyond this is detrimental to adhesion, and is attended with a risk of the excitation of undue action. In general they should not be left in beyond eight-and-forty hours; but in some cases they may advantageously be retained for a considerably longer period, provided they do not excite irritation. When they are withdrawn, care should be taken not to disturb the adhesion in their neighborhood by improper traction.

The *serrefine* (Fig. 52) may be used in some cases, especially when very accurate union of the lips of a wound is required, as in cuts upon the face.

Fig. 52.

Plasters serve to maintain the approximation of the opposed surfaces. They are of various kinds; but the resin, soap, and isinglass plasters are those that are most commonly employed. Each of these possesses peculiar properties that fit it for particular cases. The resin plaster has the advantage of being the most adhesive, and of not being readily loosened by discharges, but it is irritating, sticky, difficult to remove, and, in consequence of the lead that it contains, leaves a dirty-looking incrustation on the part.

The soap plaster is less irritating, but at the same time is less adhesive, and is consequently seldom employed in the treatment of wounds. The isinglass plaster is doubtless the most cleanly and least irritating of all, and being transparent, possesses the advantage of enabling the surgeon to see what is passing beneath it. It has, however, the disadvantage of being readily loosened by the discharges of the part, or by the necessary dressings. The plasters should be

cut into strips of sufficient length to support the sides as well as to compress the edges of the wound, and should be applied between, but not upon the points of suture, all hairs having been removed from the part on which they are laid down, and the surface being thoroughly dried. In removing them, both ends should be loosened at the same time, and the strip thus taken off without either lip of the wound being unduly dragged upon.

Collodion may often be advantageously used instead of plasters, either alone or in addition to sutures, being painted over the wound with a camel's hair brush, and thus bringing the lips into more accurate coaptation, at the same time time that it excludes the air.

[An effectual and neat application of the collodion dressing for wounds may be made in the following manner: — Strips half an inch or an inch in breadth, should be cut from some light, strong material of open texture. The fabric which for this purpose answers best, is that known in the shops as Donna Maria gauze, a variety of silk "illusion" These strips should be laid transversely across the wound, and their extremities fastened to the integument by the application of a collodion containing in solution about $\frac{1}{12}$th its bulk of Venice turpentine. The turpentine increases the adherence of the collodion, although of a slightly irritant nature when applied upon raw surfaces. In case, therefore, the surgeon desires entirely to exclude the air from the wound, turpentine should be omitted and simple collodion employed; or else collodion containing a small portion of castor oil. The advantages of this mode of dressing over the ordinary adhesive strips, or isinglass plaster, consist in its not being loosened by heat or moisture; the perfect freedom offered to the discharges; the ability of the surgeon to dispense with sutures to a great degree; and also the facility afforded for the daily examination of the lips of the wound. When it shall become desirable to remove the dressing a sponge moistened with ether should be passed over the extremities of the strips, which can then be raised without difficulty. This method of uniting wounds is especially applicable to injuries of the face, and to plastic operations, and was, we believe, first employed by Dr. Goddard, of this city.]

After coaptation has been effected by position, aided by the application of sutures and plasters, a strip of water-dressing may be laid along the line of the wound, and a piece of wet lint over the whole surface, which should be kept as cool as possible. If any ligatures have been applied to bleeding vessels, they must be left hanging out at the most dependent angle. The first dressings should be left unchanged for two or three days, the sutures may then be removed, and the plasters as they become loosened; care being taken to support the sides, and after a time to bandage the part properly by circular turns of a narrow roller. In many cases the direct union of clean cut wounds may be much facilitated by bandaging the part, so that firm pressure is exercised upon it from the very first. This requires to be done carefully and with due attention to the proper support of the deeper parts, lest infiltration of sero-sanguinolent fluid occur in them, which will readily lead to suppuration.

Union may be readily accomplished in many slight incised wounds, by covering the edges of the cut with a piece of soft lint soaked in collodion. Direct cohesion, by a process analogous to scabbing, taking place under this dressing.

If union by the first intention fail, or if the wound occur in such a constitution that it is useless to attempt it, inflammation takes place in and around it, the lips swell and become red, a sero-sanguinolent discharge, gradually assuming a puriform character, exudes; and, at the same time, if the wound be an extensive one, suppurative fever sets in. Under these circumstances, the sutures should be immediately removed: the strips of plaster, if continued, should be used merely for support and not for union; a large soft linseed-meal poultice, or a thick piece of warm water-dressing, should be applied; and the patient put

upon a moderate antiphlogistic regimen. When suppuration has fairly set in, and granulations have sprung up, the treatment must be conducted in accordance with those general principles that guide us in the management of ulcerated surfaces. The suppuration must be moderated, the process of cicatrization facilitated by the application of a bandage, the general health attended to, and the strength of the patient supported.

Union by "secondary adhesion" may sometimes be accomplished, after that by the first-intention has failed, by bringing the granulating surfaces together a second time by means of sutures, harelip-pins, or plasters.

Faulty cicatrices often give rise to great disfigurement, and require some operative means to remedy this inconvenience. These *plastic operations* will be described more fully hereafter, but it may be stated here that much benefit will occasionally result by the excision of the cicatrix, and then bringing together the opposite edges of the wound in a uniform line. Should it be too large for this, if flat it must be left, but if angular it may be divided down to the second structures beneath, and the gap thus resulting, filled up by a flap of sound integument dissected up from the neighboring parts and twisted into it.

CONTUSED AND LACERATED WOUNDS

May be defined to be wounds that are conjoined with more or less bruising about the edges and sides; presenting every possible variety in the degree of contusion and of wound, from a cut on the shin to a limb crushed and lacerated by a cannon-shot. They are commonly inflicted by blunt cutting instruments, as in chops by a hatchet, or by stones, bludgeons, &c. Lacerations by machinery, in which parts are torn off or crushed; the bites and gorings of animals, and gun-shot injuries of all kinds, come under this denomination.

Whatever their mode of infliction, these wounds present certain characters in common, by which they differ from all other injuries. Their lips are irregular and torn, less gaping than in incised wounds, but surrounded by more or less ecchymosis and contusion, with a tendency to slough on their sides. There is usually but little hemorrhage, and the pain is of an aching or dull character. In consequence of the sloughy state of the lips and sides, these wounds always unite by the second intention.

Contused and lacerated wounds present peculiarities according to their mode of infliction.

When occasioned by the bite of a large animal, the part injured becomes very painful and inflames extensively, the wound being lacerated, much contused, and often penetrating deeply. It sloughs in consequence of the pressure to which it has been subjected, and of the animal shaking and tearing the part seized. When the wound is inflicted by the tusk or horn of an animal, it is extensively lacerated rather than contused, and often partakes of the nature of punctured wound.

When a part of the body is torn off, the wound presents peculiar characters, which differ, however, according as the separation is effected at the part struck or seized, or at a distance from it.

In the first case — as when a cannon-ball carries off a limb, or an arm is caught in a steam-mill or rag-tearing machine and crushed or torn off, the stump presents a very ragged surface, the skin being stripped away higher than the other parts, the tendons hanging out, and the bellies of the muscles that are torn across being swollen, protruding, and apparently constricted by the lacerated integument. A most important condition in these wounds is that of the vessels; these are separated lower down than the other parts, for being elastic they elongate and pull out before they give way. There is no hemorrhage, because the inner and middle coats of the artery breaking off short, allow the external one to be dragged down and twisted over its mouth in such a way as to offer a

complete barrier to the escape of blood. The bone is crushed off at the end of the stump, of which it forms the conical apex.

Occasionally when parts are pulled off, they are separated at a distance from the point seized. Thus fingers that have been torn off by machinery have their extensor tendons separated higher up, at their junction with the belly of the muscle, and not at the part seized; the tendon being drawn out of its sheath, and hanging on to the separated end in a ribbon-like manner.

In the *progress* of a contused or lacerated wound there are two distinct periods: — 1st, that of the separation of the slough produced by the contusion; and 2dly, that of repair by granulations of the chasm left.

The extent of the slough depends not only upon the extent, but also upon the situation of the injury. If the parts around the wound be much bruised, then superficial sloughing to a great extent may occur; if the wound be deep though not extensive, there will always be danger of troublesome sloughing, leading to suppuration, and burrowing of matter, and in some cases to secondary hemorrhage. Those wounds that are situated immediately over bony points — as the shin and elbow — are especially tedious, as the slough frequently implicates the fasciæ. The scalp, however, has a less tendency to slough than any other part of the cutaneous surface. This is owing to its great vitality, and the large supply of blood it receives from closely subjacent arteries. In all cases of contused and lacerated wounds — but more especially in those of the scalp — there is great danger of the supervention of erysipelas. But the chief danger to be apprehended in wounds of this description is the supervention of gangrene. In these cases gangrene may occur in three ways: —

1stly. The contusion always kills a thin layer of tissue, which forms a slough on the sides or lips of the wound; but in some cases the violence done to the part is so great as directly to kill its whole substance. Thus if a finger is crushed to a pulp by machinery, all circulation is completely and at once arrested, and the vitality of the part destroyed outright. If the violence be not quite so great as this, the vitality of the part may be so lessened, and its resisting power diminished to such an extent, that the inflammation necessary for the repair of the injury terminates in gangrene. This is a local traumatic mortification, evincing no disposition to spread beyond the part injured, but being bounded by a line of demarcation along which it will separate. It is not always easy to distinguish this direct form of gangrene from such discoloration and disorganization of a limb as is still compatible with life. In all cases of doubt the surgeon must wait, and a very short time — a few hours — will be sufficient to declare whether the vitality of the part can be maintained or not. In cases of much doubt there can be no objection to make an incision into the part, and thus ascertain the true state of things. But this should not be done if it can possibly be avoided.

2dly. The injury may be chiefly inflicted upon the great vessels of the limb, damaging them to such an extent as to interrupt completely the circulation; gangrene being thus induced indirectly in the parts supplied by them. This form of gangrene we shall have occasion to treat of fully when speaking of injuries of the arteries.

3dly. The true traumatic or "spreading gangrene," the most fatal variety of mortification, may occur from comparatively slight wounds, in consequence of some constitutional disorder; but most commonly it is the result of severe contused and lacerated injuries, and fractures. It has a tendency to spread rapidly, especially through the cellular planes of the limb, often involving the whole member in less than twelve hours after its invasion. Its occurrence is indicated by the injured limb becoming cold, being greatly swollen and readily pitting, afterwards by much tension and œdema of the subcutaneous cellular tissue, causing the part to assume a brawny hardness; — there is sometimes crackling from the generation of gas. The skin is at first of a dull, tallowy-

white or bluish color, mottled or marbled by bluish-green streaks in the course of the veins, but speedily assumes a yellowish-hue, bullæ containing dark fluid often rising upon it. The constitutional symptoms set in very early, are for a short time indicative of much febrile action, but very speedily assume an asthenic form. Death usually occurs in the course of from thirty-six hours to four days; and always very shortly after the gangrene has reached the trunk.

The peculiarities of this form of gangrene consist in the rapidity of its progress, its great fatality, and the tendency it has to affect and spread along the cellular tissue of the limb in preference to any other part. It is truly a constitutional affection, depending rather on the state of the blood than upon the local injury. Thus in some cases we see it follow comparatively slight contused wounds, whilst in others the most serious crushes and injuries may occur without it. It appears to be closely associated in its occurrence with those conditions of the system that dispose to the supervention of erysipelas, phlebitis, and other inflammatory diseases of a diffused or spreading character; and hence its great fatality. From the other varieties of traumatic gangrene it differs remarkably, not only in the rapidity of its extension and the general appearance presented by the parts affected, but more especially in the little disposition it manifests to limit itself by a line of demarcation or by any adhesive action.

Treatment of contused and lacerated wounds. — In the treatment of the slighter forms of these injuries we must bear in mind the occurrence of the two periods; those of sloughing and of granulation. There is also in all injuries of this description a special tendency to the occurrence of erysipelas and allied diseases.

In these cases care must be taken to clean the parts thoroughly from foreign bodies that are frequently impacted or ground into them. However contused and torn a flap of skin may be, it should never be separated, provided it maintain any attachment to the neighboring tissues, but always be replaced on the chance of its vitality being preserved. If it live, as it will often do, especially about the scalp, under apparently the most discouraging circumstances, much will be gained; if it slough, no harm can result from the attempt to preserve it. There are even cases on record, in which parts that have been completely separated have become attached by being immediately reapplied to the surface from which they had been torn. Whether this be actually the case or not, it is at all events certain that a very small tongue of skin is sufficient to maintain the vitality of a part. This we see exemplified in the operation for the restoration of a lost nose; and cases have occurred to me in which the nose, nearly cut off, being only retained by a portion of one ala, has readily united on being replaced; so likewise in bad cases of compound dislocation of the fingers, the part has been saved, though merely attached by a narrow bridge of skin. After a part has been replaced in this way, it should be retained in situ by a few points of interrupted suture, with a piece of lint soaked in collodion applied to the line of wound. The sutures must be left in for a somewhat longer time than usual, until good union has resulted.

In ordinary cases of contused or lacerated wounds, whether superficially extensive or deep, we must facilitate the separation of the sloughs by the application of poultices, which also serve to subdue local inflammation. About the period at which the slough begins to be loosened, there is danger of the occurrence of hemorrhage if a large artery have been implicated in the injury. When hemorrhage occurs in this way it usually sets in from the sixth to the twelfth day, and may be speedily fatal. After the sloughs have separated, an ulcer is left, which must be treated on general principles.

In the more severe cases of contused or lacerated wounds any attempt at saving the part may be hopeless, and the patient's only chance lies in amputation. In determining the expediency of operation, two questions present themselves: 1stly. The nature of the cases in which amputation should be performed;

and, 2dly. The time at which it should be done, whether immediately after the infliction of the injury, or at a subsequent period. It is difficult to lay down more than very general rules as to the kind of cases that require amputation, so much depending on the age, constitution, and previous habits of the patient. In all cases the surgeon should be careful not to condemn a limb that admits of a fair chance of being saved; and, if the patient should happen to die, as he often may, from the after-effects, such as erysipelas or phlebitis, of a contused wound that admitted of a fair prospect of recovery, the surgeon may justly console himself with the reflection, that, with the constitutional disposition leading to these diseases, the injury inflicted by the amputation would in all probability have been equally fatal, and that thus the patient has been saved the pain of an operation that would have been unsuccessful in its result.

As a general rule, severe injuries are more readily recovered from in the young than in the old, their vitality and elasticity of constitution being greater, with less tendency to consecutive diseases. Much will depend upon the habits of the patient, or upon the existence of visceral disease at the time of the injury. In persons who have been free livers, and who have that peculiar irritability of system conjoined with deficient power, so commonly observed in such subjects; and more especially if there be already existing disease of the liver or kidneys, contused and lacerated wounds are apt to be followed by the worst forms of erysipelas and traumatic gangrene, and thus to be speedily fatal. Injuries of the upper extremity are less serious than those of the lower; its supply of blood being proportionably greater and more uniformly distributed. In some badly-contused wounds, also, of the arm and hand, as in bad lacerations with fracture about the shoulder, elbow, or metacarpus, resection of the injured part may be performed instead of amputation of the limb.

Though there may always be this doubt as to the cases that should not be amputated, there are certain conditions in which the surgeon need never hesitate to perform this operation, as the only chance of saving the patient's life.

The following are the cases of severe contusion and laceration in which the limb should be amputated; either with the view of preventing the occurrence of gangrene, or in order to remove a mortified part from the body, and thus to save the life of the patient at the expense of the injured limb:—

1st. If a limb has been torn off by machinery, carried away by a cannon-ball, or cut off by the passage of a railway train over it, the irregular and conical stump should be amputated, so as to leave a more useful and healthy one to the patient;—

2d. If the whole thickness of a limb—the soft parts and the bones—be thoroughly disorganized and crushed, it must be removed;—

3d. If the soft parts are extensively stripped away from the bones, though these be entire, so much sloughing and suppuration would ensue as to leave a useless limb, and amputation should be performed. It is in these cases that it is often especially difficult to estimate the amount of injury that cannot be recovered from, this depending so much upon the age and constitution of the sufferer. I believe that surgeons, in their anxiety to save a limb, often lose a patient under these circumstances. I have more than once had reason to regret having attempted to save limbs injured in this way, and believe that if the skin of the lower extremity be extensively torn down and the muscles much lacerated, so as to slough away, there is but little chance for the patient—unless he be very young, and of a remarkably sound constitution—except in amputation. In the upper extremity it is different; there recovery may take place under the most adverse circumstances.

4th. If the bones are extensively comminuted and crushed at the same time that the soft parts are much lacerated, there can be no question about the propriety of removing the limb.

5th. So also if the knee be largely opened, with laceration of the soft parts,

and perhaps fracture of the contiguous bones, the limb must be amputated. Corresponding injuries of the ankle, shoulder, and elbow joints, may, as has already been stated, admit of resection rather than of amputation.

6th. Bad crushes of the foot have a great tendency to run into gangrene, and hence require amputation. In the hand, on the contrary, very extensive injuries are often recovered from, without this operation being necessary; and in many cases partial resection may be substituted for it.

7th. In those cases in which a large artery, as the femoral, is lacerated at the same time that the soft parts are extensively injured, and the bone fractured, amputation is required in order to prevent the occurrence of gangrene. In the more local form of traumatic gangrene, in which the disease is confined to the part directly crushed and injured, no good can come of delay, and amputation should be performed so soon as mortification has declared itself; and the limb must be removed at a sufficient distance from the seat of mischief. Thus if gangrene of the foot or ankle come on in consequence of a smash of these parts, the upper part of the leg or thigh should be amputated. When the mortification results indirectly from injury of the vessels, the limb should also be immediately removed in a line with the wound, unless this be too high up; then the most favorable point must be seized, as will hereafter be explained. Amputation under these circumstances is by no means a very unfavorable operation, and one that I have several times successfully performed, provided it be done sufficiently early, before the constitution becomes poisoned by the absorption of morbid matters from the gangrenous limb. It is scarcely necessary to warn the surgeon to be certain of the existence of gangrene before he operates; and also that it be not a mere limited slough, but sufficiently extensive to jeopardize the patient's life.

In all cases in which the true traumatic or rapidly spreading gangrene has set in, the surgeon will be placed in a great difficulty which ever way he act. If he leave the patient to nature, in the hope of a line of demarcation forming, he will almost certainly be disappointed, the gangrene rapidly spreading up to the trunk; and if he amputates, he will probably lose his patient by the stump becoming affected. Yet amputation should, in my opinion, be performed at once. For although this operation is necessarily very unfavorable, when practised in these cases, in consequence of the gangrene not being a local affection, but dependent on constitutional causes, yet it must be remembered that if the surgeon wait for the line of demarcation, or trust to other means, such as incisions or general treatment, the patient will almost to a certainty die. The patient's safety in these cases lies in amputating early, and removing the limb high above the part affected; thus in spreading gangrene of the arm, at the shoulder-joint; and of the leg, in the upper part of the thigh. The necessity for high amputation in these cases is owing to the gangrene spreading more extensively in the cellular tissue than it does in the skin; and hence in reality invading the limb to a higher point than it appears externally to do. A principal source of danger, and of death, after amputation in these cases, is the great disposition to the recurrence of the morbid condition in the stump. Out of ten cases in which I have seen or done amputation for this disease, this recurrence happened in five instances. This tendency will be increased by the proximity of the line of amputation to the gangrenous limit. But even under the most unfavorable circumstances recovery will sometimes take place. Thus I have seen the flaps in amputation for spreading gangrene infiltrated with gelatinous looking fluid, and yet recovery take place. In a man whose arm I amputated at the shoulder-joint for spreading gangrene of the limb, the infiltration had extended as high as the scapula, but yet he made a very excellent recovery.

Much of the success of the case will depend on the after treatment. Light dressings to the stump, the administration of full doses of liquor opii, and the

early and free administration of nourishment and stimulants, are the principal points to be attended to; and attention to these will often bring the patient through, though usually not without much difficulty and great constitutional disturbance.

The next question, as to the period at which amputation should be performed in contused wounds, has already been considered at page 44. It may be generally stated that the sooner a condemned limb is taken off, the less is the suffering, and the better the chance of recovery to the patient, and that, consequently, primary amputation should be practised in these cases. For notwithstanding the higher rate of mortality in primary than in secondary amputations, it is absolutely necessary in many cases to remove the injured limb within the first twenty-four hours. This higher mortality may partly be dependent on the accidents that require primary amputation being more severe than those in which it has been thought justifiable to attempt to save the limb; and certainly of the two alternatives of leaving a badly-crushed and mangled limb on until suppuration is set up, and thus exposing the patient to all the risks of gangrene, erysipelas, pyemia, &c., or removing it at once, the latter is the one attended with least danger to the patient.

CHAPTER VII.

GUN-SHOT WOUNDS.

Amongst the special varieties of contused and lacerated wounds, none are of more interest than the different forms of gun-shot injury. Though comparatively and fortunately rare in civil practice in this country, yet they are of sufficiently frequent occurrence to render an acquaintance with them indispensable to the general surgeon. To the military surgeon their study is necessarily one of peculiar interest and importance, and to him I would specially recommend the perusal of the works of Hennen, of Guthrie, of Ballingall, and of other surgeons who have had unusual opportunities of studying the nature of these injuries upon the field of battle, and by whom they have been treated with all the minuteness of a speciality. I purpose in the following observations rather to confine myself to such a general discussion of the subject as is required by the civil practitioner, than to enter into it with all the minuteness of detail that may be thought necessary to the military surgeon.

Gun-shot injuries constitute a species of contused and lacerated wounds, characterized in some cases by the peculiar appearance presented by the color, shape, and size of the orifice; and in others, by the extensive injury inflicted to parts, both superficial and deep-seated, in consequence of which they may prove immediately or rapidly fatal. If the sufferer survive, high inflammatory action, with much pain and tension, with profuse discharge, deep-seated suppuration, and other after-consequences of a serious and very protracted character, are apt to set in. These peculiarities were at different times attributed to the parts being burnt by the ball, to the poisonous nature of projectiles, and to electricity, developed by the bullet in its passage through the air, or by its friction against the barrel. All these opinions, however, have been shown to be erroneous, and every peculiarity presented by these injuries can be accounted for, by the bluntness of the contusing body, the rapidity of its course, and the force with which it is driven. That the sloughing which always occurs in the

track of a bullet-wound is due to the injury being inflicted by a blunt body, is evident from the fact, that sharp splinters of shell have been known to inflict clean-cut wounds.

Gun-shot wounds vary greatly according to the nature of the projectile, to the force with which it is driven, and to the direction in which it strikes.

As to the nature of the projectile: — Gun-shot injuries of a serious character may be inflicted by weapons charged only with powder. This may injure by the mere concussion of the explosion; thus a pistol charged with powder, and discharged with the muzzle resting against the chest of a man, has been known to kill by concussing the heart. In other cases a portion of the powder unexploded may be driven into or through the skin by that which is exploded behind it. In this way very troublesome and disfiguring marks are not unfrequently inflicted on the face, and other parts of the body, by the charcoal of the powder being driven into the skin. That a weapon so charged may actually kill, appears from a case related by Dupuytren, in which a fowling-piece charged with powder only, and fired at the distance of two or three feet from the abdomen, pierced the belly with a round hole and killed the man. The force of the explosion only will sometimes produce serious lacerations. Suicides occasionally forget to put a bullet into the pistol, and discharging it into their mouths, blow open the cheeks and injure the pharynx and glottis by the explosive force. Some years ago, a man was brought to University College Hospital, who had discharged the tube of an *Italian iron* loaded with powder only, into his mouth, and died in consequence of the injuries he received. In another case that occurred in the same institution, a man died on the fifth day after firing a pistol into his mouth, from sloughing of the pharynx and inflammation of the glottis and larynx, in consequence of the scorch of the explosion interfering with respiration, and thus producing suffocation.

Wadding and soft materials, as pieces of clothing, will occasionally inflict serious wounds by the force with which they are driven. These injuries often happen on the stage, at reviews, fairs, &c. Taylor relates several instances of the kind;—a girl killed by having a gun charged with paper pellets discharged at her; also, that of a man who was killed by a kid-glove fired from a blunderbuss.

Small shot often inflict serious injuries, and these are most commonly met with in civil practice. If the person wounded be within a few feet of the muzzle of the gun, a terribly torn and lacerated wound, of a very serious character, even worse than that occasioned by a bullet, will be inflicted; for the shot not being scattered, is driven through the body in a solid compact mass, tearing the tissues to a great extent.

The shot scattering as it flies, produces at a greater distance a less serious injury, usually lodging in the subcutaneous cellular tissue, where it may remain for years, requiring to be picked out with a lancet, or it may give rise to suppuration. Occasionally, the shot, by penetrating an important part, may cause serious or fatal results; thus, a single shot penetrating the eye-ball will destroy vision; or, lodging in the heart, or the femoral vein, has been known to give rise to rapidly fatal results. A patient was brought to Univerity College Hospital, who committed suicide by firing a pocket-pistol loaded with small shot into the mouth; after death, the shots were found to be deeply lodged in, and to have penetrated the anterior portion of the vertebral column.

Splinters of various kinds, of metal, wood, or stone, carried by the force of the explosion, as in blasting and mining operations, inflict perhaps the worst forms of gun-shot injury that are met with in civil practice. In naval actions the force with which splinters of wood are driven, when struck and scattered by cannon-shot, is so great as to inflict the most serious and fatal mischief. A particular form of injury, not unfrequently met with in civil practice, and which belongs to this class, is the wound of the right eye-ball, by the explosion and splintering of faulty percussion-caps.

Bullets, slugs, and grape-shot occasion more serious wounds than any that have yet been described; lacerating soft parts, fracturing and crushing bones, tearing asunder vessels and nerves, perforating the viscera, and occasionally cutting off parts, as a finger, the nose, or an ear, and thus giving rise to every possible variety of injury.

In the majority of cases, a bullet traverses, and the wound has two apertures, one of entry, the other of exit; occasionally it happens, however, that in consequence of the ball being spent, or of the piece not being efficiently loaded, or of the oblique direction with which it strikes the part, it merely leaves a contusion or dent, rebounding or glancing off. In other cases, there is only one aperture, and here the bullet has probably lodged in the soft tissues, in a bone, or in the cavity of a hollow organ, as the bladder. It sometimes happens, however, that the ball drops out through the aperture at which it entered, as when a spent ball strikes a rib; or, that it carries a pouch of clothing before it, which enables the surgeon to withdraw it. One bullet may even make more than two apertures; thus, a ball has been known to split against the sharp edge of the tibia, and to have one aperture of entry and two of exit; or it may pass through both thighs, or both calves, and thus occasion four apertures, and cases have been recorded in which five wounds even have been made in the same person by one bullet.

The direction of these openings is often of importance, in a medico-legal, as well as in a surgical point of view. Thus, Sir Astley Cooper, by attending to this circumstance in a case of murder, ascertained that the fatal shot must have been fired by a left-handed man, and thus led to the detection of the criminal. These apertures, though usually opposite to one another, when a ball traverses, will sometimes take a very remarkable course, the bullet being deflected by meeting with obstacles from bones, or by the elasticity of the skin. Thus, a bullet has been known to strike a rib and to be deflected, running under the skin to the opposite side of the body; so again, striking one temple, it has been carried under the scalp to the other side of the head, where it has passed out; thus giving the appearance of having penetrated important cavities which in reality were not wounded.

Fig. 53.

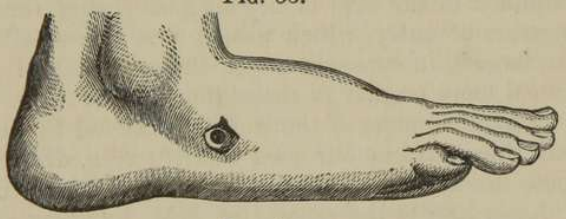
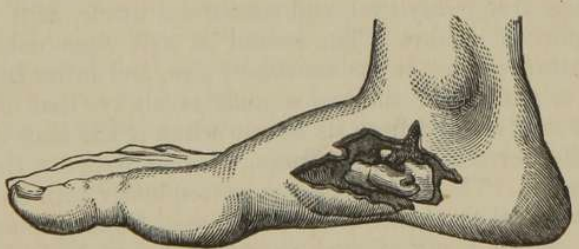


Fig. 54.



The apertures of entry and of exit, made by a round bullet, deserve attentive consideration. Much discussion has arisen as to whether there is any difference between these apertures, and if so, to what it is owing. That there is a difference in the great majority of cases there can be no doubt. The hole made by the entrance of the ball being small, depressed, and circular, scarcely admitting the introduction of the little finger (fig. 53), whilst that made by its exit is a large, somewhat everted, and irregular aperture into which two or three fingers may be freely passed (fig. 54). In some cases, however, it is equally certain that there is no appreciable difference between the two, and in others that the aperture of entry is larger than that of exit.

There can be no doubt that Mr. Guthrie has given the correct explanation of these discrepancies when he states, that the amount of the difference in the two apertures will depend partly on the momentum of the ball, and partly on the resistance it meets with. If the ball strikes shortly after its discharge, when at the maximum of its velocity, it will make but a small round hole; not so much shattering the parts as separating them. If it traverse a part composed of soft tissue, meeting with but little resistance in its passage, it loses but little of its momentum, and passing out of the body with nearly the same force with which it entered, it makes an aperture of exit that differs but slightly, if at all, from that of entry. If the ball strikes a bone on its passage through the limb or body, and thus, by meeting with much resistance, have its momentum materially lessened, the aperture of exit will be torn, large and ragged, differing materially from that of entry. So also we find in all bullet-wounds the entrance aperture is actually less in diameter than the bullet itself, provided it be made whilst the ball is moving with its full velocity; if it have nearly lost its momentum before it strikes, then the entrance-wound will always be large and ragged. In this there is nothing peculiar to the tissues of the living body, the same happens when any elastic material, as a piece of green timber, is struck. Much, however, will also depend on the period at which the wound is examined. In the early stages, for the reasons mentioned, the wound of entry is smaller than that of exit, but as the eschar which forms in the wound of entry is larger than that at the exit aperture, the former may, in a later stage, appear larger than the latter. This difference in the size of the two wounds I saw well exemplified in the case of a young man, shot through the neck in a duel. The aperture of entry, which was at first the smallest, appeared on the second day the largest, in consequence of the extrusion of a black eschar; though it continued more regular in shape than that of exit.

[The characters of the wounds inflicted by the Minié ball, and by the conical ball thrown from our own Sharp's rifle, differ materially in appearance from those described in the text as produced by the ordinary round bullet.

According to the reports of MM. Baudens and Scrive, French military surgeons in the Crimea, the wound of entrance made by the conical projectile, is most frequently oval, and sometimes linear, as if it had been produced by the point of a sabre. The wound of exit does not differ ordinarily from that of entrance, save in its increased size, and in its irregular appearance. The relative position of the two wounds is always that of a straight line, as the ball is never deflected from its course when it has once entered the body. All tissues, whether muscle, aponeurosis, or bone, between these two points, are alike penetrated. The soft parts are consequently torn and lacerated to a very great extent, and the bones frequently present badly comminuted fractures.

As the result of such extensive lesion, violent traumatic inflammation commonly sets in, extending over a vast surface, leading in many instances to gangrene, and frequently imposing upon the surgeon the necessity of amputation.]

Cannon-balls inflict two kinds of injuries. They may contuse a part without destroying the integrity of the skin, the ball striking obliquely, or rolling over the surface of the body. The elasticity of the skin prevents this from injury, though all the subjacent textures, bones, muscles, and vessels, may be totally disorganized and crushed into a pulp, if a limb be struck; if the trunk itself be injured, the vertebral column and lumbar muscles may be disorganized, and the liver, kidneys, spleen, stomach, and intestines ruptured, without any breach of surface. These injuries, formerly erroneously attributed to the action of the current of air set in motion by the ball, go by the name of *wind contusions*. In some of these contusions gangrene of the limb sets in, apparently, as Mr. Guthrie has pointed out, from the rupture of the principal vessels.

Cannon-shot more commonly carry away the whole thickness of a part, tearing

and shattering a limb, carrying off the thick and fleshy parts of thigh, calf, or shoulder; or they may inflict the most fearful injuries, by smashing the trunk and head.

In gun-shot injuries, the shock to the nervous system is always very great where parts of importance, as the head, chest, and abdomen, or large joints as the knee, are opened, and the severity of the shock is indicative of the amount of mischief inflicted. Thus if a bullet appears to have traversed the chest, but in reality has been deflected under the skin, the comparative absence of shock will serve, to a certain extent, to prove the absence of visceral mischief. In some cases the shock alone appears to be sufficient to kill; thus, a man shot by a pistol-bullet, which traversed the distended stomach, died in a few seconds from shock, there being no bleeding of importance, or other cause of immediate death discernable (Taylor). In some cases, however, that are mortal, the symptoms of shock are but slight.

Gun-shot wounds being contused, do not in general bleed much, when merely fleshy or muscular parts are perforated or even carried away. But in many cases, patients lose their lives from immediate hemorrhage; the larger arteries, when cut across by a bullet, bleeding as freely as if divided with a knife.

Gun-shot wounds always inflame, with much swelling and tension of the part. The pain which, at the moment of infliction, may not have been severe, becomes extremely acute when inflammation has set in, owing principally to the great tension that takes place. This, indeed, is one of the most remarkable phenomena of gun-shot injury, and, by giving rise to strangulation of the tissues, is often the cause of serious mischief. The inflammation speedily terminates in suppuration, not only in the track of the ball, but widely diffused through the neighboring parts. A period of great danger in gun-shot wounds is that about which the sloughs begin to separate, usually from the twelfth to the twentieth days; and up to this time it is often impossible to know the precise extent of the disorganization. At this period, also, "consecutive hemorrhage" is very apt to come on, after very slight exertion, without any warning. This may be suddenly fatal, and is always more dangerous than the primary hemorrhage, not only on account of the difficulty of arresting it, but likewise from the patient being already weakened by inflammatory and suppurative action. At a still later period than this, the patient, if his limb be saved, may have to undergo long and tedious processes of exfoliation of dead bone, and to run the risk of intercurrent attacks of erysipelas, hospital gangrene, and visceral mischief.

Treatment.—Some of the slighter forms of gun-shot injuries, those of a purely superficial character, merely require to be treated on the ordinary principles that guide us in the management of contusions and lacerations. When they affect the head, chest, and abdomen, they present so many circumstances of special importance that we must defer their consideration until we come to treat of injuries of those regions. Gun-shot wounds of the extremities may be divided into two great classes in reference to treatment. 1st. Those that do not require amputation. 2d. Those in which amputation is necessary.

In all cases of gun-shot wound, whether amputation be ultimately required or not, certain *immediate attentions* are necessary in order to place the sufferer in some degree of comfort and safety. Thus, if a person be shot through the fleshy part of a limb, no bone or vessel of importance being injured, the part should be covered with wet cloths, and placed in an easy position. If there be abundant venous hemorrhage the limb should be raised, and if this do not arrest the bleeding, a compress used. If the hemorrhage be arterial, a tourniquet must be applied. So, also, a tourniquet should be applied if there be rapid dripping of blood, even though the bleeding be not in a jet.

If a limb be smashed, or torn away, a tourniquet should be applied very tightly upon the stump, which must be covered up in wet cloths. The pressure of the tourniquet will not only arrest hemorrhage, but will stay that spasmodic

quivering of the muscles of the mangled limb, which is so painful to the sufferer.

If the head or neck be wounded, cold wet pledgets should be applied, and hemorrhage, whether venous or arterial, arrested by pressure with the fingers.

If the chest be shot through, the patient should be laid on the injured side, and cold applied. If emphysema occur, or if air freely pass through the wound, a body bandage must be tightly applied.

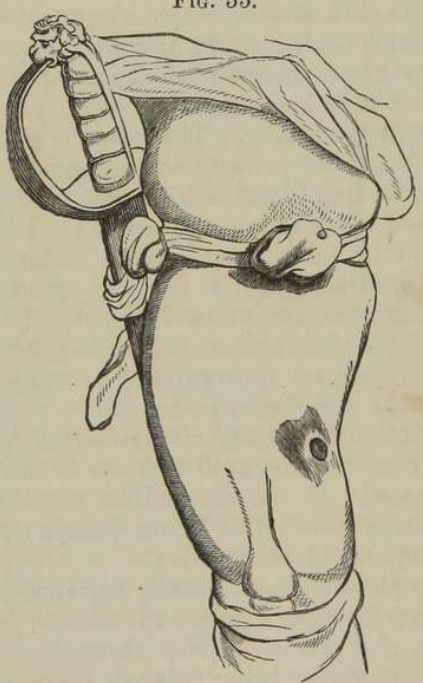
If the abdomen be wounded, the patient should be laid on the injured side, if the aperture be a lateral one. If central, on his back, with the knees bent over a log or knapsack. If the intestine protrude, wash and quickly return it.

In addition to these immediate attentions, which may be bestowed upon sufferers from gun-shot before they are sent to the hospital for more methodical treatment, the influence of the shock should be counteracted by the administration of a little brandy-and-water, and plenty of cold water be given to allay thirst.

1st. Those cases of gun-shot injury that do not require amputation, must be treated on the principles that guide us in the management of all contused and lacerated wounds, the surgeon, however, bearing in mind that these injuries are especially apt to be followed by extensive and intense inflammatory action, and that sloughing will inevitably result in every part that has been touched by the ball.

The first point to be attended to in these cases is *the arrest of hemorrhage.* In general this may not give much trouble; but if a large vessel be injured, the loss of blood will rapidly prove fatal, unless stopped. This is done, in the first instance, by direct pressure with the fingers on the bleeding part, followed by the application of the tourniquet, or, if this instrument be not at hand, by some simple substitute, such as rolling a pebble, about the size of an egg, in the middle of a pocket-handkerchief, laying this over the artery, knotting the ends of the handkerchief round the limb, and then twisting it up tightly with a piece of stick, or the hilt of a sword, passed under it (Fig. 55). The wound in the artery may be of such a kind as to require amputation of the limb; if not, hemorrhage must be permanently arrested by an incision being made down to the bleeding vessel, and a ligature applied on either side of the wound in it; for reasons that will be fully stated when we come to speak of injuries of arteries.

Fig. 55.

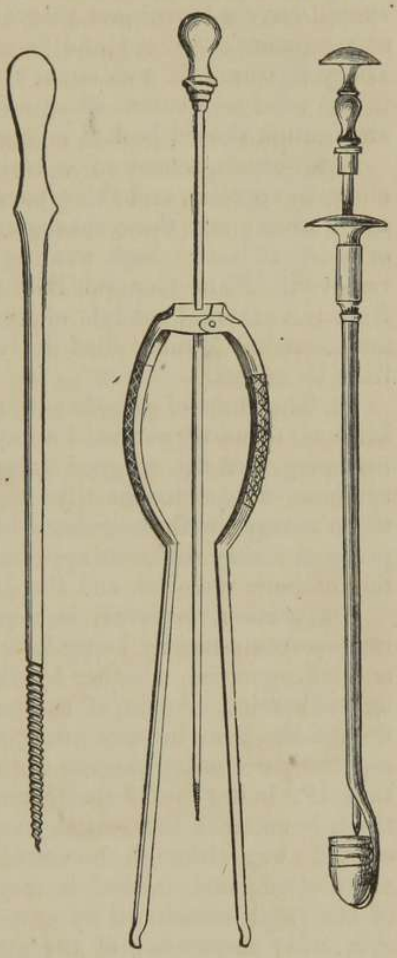


The next point to be attended to is *the extraction of foreign bodies*, such as splinters of bone, shot, slugs or bullets, wadding, pieces of clothing that have been carried in with the ball, and other matters of a like kind. These will generally be found near the aperture of exit. *Splinters of bone* require special attention. Those that are quite loose and carried away from the shaft must be taken away, as they will necrose and produce the same irritation that other foreign bodies would. If splinters are still attached to soft parts, though carried considerably away from the portion of bone to which they were attached, they must also be taken out; but if they

continue attached in the vicinity of the fracture, they must be left, becoming enveloped in and tending to consolidate the callus that is thrown out for its repair, and thus adding eventually to the strength of the limb.

If the bullet lodge, it, together with foreign bodies accompanying it, such as pieces of clothing, must be cut out by a counter opening. If anything is very tightly fixed, so that it cannot readily be removed, it must be left till loosened by suppuration. In searching for bullets and other foreign bodies, care should be taken not to probe the wound unnecessarily from mere curiosity, or so as to excite irritation: in many cases, the introduction of the finger is far more useful than that of the probe. Various instruments are used for the removal of bullets and other foreign bodies. The accompanying wood-cuts (Figs. 56, 57, and 58) represent the best forms of bullet-screws and forceps. The probes are usually made much larger and stronger than those in ordinary use.

Fig. 56. Fig. 57. Fig. 58.



In those cases in which small shot are lodged under the skin, they may be turned out by being cut down upon with a fine scalpel.

Our next object should be the treatment of the wound itself. This, as has already been stated, will always inflame violently and slough along the whole track of the ball. The principal points to be attended to are, consequently, to limit the inflammation, and to facilitate and watch the suppuration of the sloughs.

In order to *limit the inflammation*, it was a common practice with military surgeons, and still is so with the French,[1] to dilate, by incision, the wound made by the ball, with a view of preventing tension and strangulation of parts. Since the time, however, that John Hunter pointed out that an incision could not alter the nature of a contused wound, and only superadded another injury to the one already inflicted by the bullet, British surgeons have only employed the knife in the early stages of gun-shot wounds, for the purpose of securing bleeding vessels, or to facilitate the extraction of foreign bodies. In the more advanced stages, however, free incisions, which should be made in the direction of the axis of the limb, are commonly required, in order to lessen inflammatory tension, to prevent the extension of sloughing, and to favor the escape of matter.

The best mode of lessening inflammation in a gun-shot wound is by cold irrigation (fig. 45), conjoined with position and rest; to which water-dressing and poultices, useful as they may be, are far inferior. As suppuration comes on, we must substitute warm applications for the cold, so as to hasten the for-

[1] [In Baudens' Treatise on Military Surgery, already quoted (Paris, 1858), this custom of the dilatation of gun-shot wounds by incision is most strongly reprobated. As long ago as the year 1836, this writer had already stigmatized the process as "useless and barbarous;" and he now adds that, during the Crimean war, he had observed with satisfaction that the practice possessed not a single defender.]

mation of matter and the separation of the sloughs. Free incisions will also now be required. These should not be delayed too long; they may be practised when the part has become swollen with much tension, in order to prevent the deep mischief that must otherwise ensue. At the period of the loosening and separation of the sloughs there is always especial danger of the supervention of consecutive hemorrhage. The patient, consequently, at this time requires to be carefully watched: if the wound be in the vicinity of large vessels, he should have a tourniquet placed loosely round the limb, so as to be screwed up at a moment's notice; and he must, on the supervention of bleeding, have the artery ligatured, if possible at the seat of the wound; if this be not practicable, in the most convenient situation above it; and if this do not arrest the bleeding, amputation should be had recourse to.

After-consequences of a serious character, such as abscesses, profuse discharges, necrosis, and the separation of splinters of bone, must be looked for in many cases; and these consequences may be prolonged for a considerable series of years, at last perhaps wearing out the patient if the cause of irritation be not removed. Thus General Bem required to have a bullet removed by Liston from the external condyle of his femur nineteen years after it first lodged there; and Marshal Moncey died forty years after the receipt of a gun-shot wound, from its effects.

2d. The cases of gun-shot injury that require amputation are of a very similar kind to those of contused wounds generally, in which the same operation is necessary, and the surgeon must exercise the same amount of caution not to condemn a part too hastily; for a part that looks much shattered and injured when covered with coagulated blood and dirt, before being cleaned and put up, presents a very different appearance after the fracture has been reduced, splinters of bone removed, and the soft parts brought properly together.

Amputation, however, is required when the whole limb is carried off, a ragged stump merely being left; so, likewise, if the limb is completely crushed and disorganized, whether by direct blow or by a wind contusion, though still left adherent. Again, if the principal vessels and soft parts be carried away, though the bone be uninjured, the limb cannot be preserved. Amputation is especially necessary in some of the more serious injuries of the lower extremity; thus, if a bullet divide the femoral vessels, or the sciatic nerve, and splinter the thigh bone, or if the sciatic nerve and soft parts at the back of the thigh be carried away, although the vessels and bone be left uninjured, the case is one for amputation; and, indeed, it may be stated generally, that compound fractures of the thigh occasioned by gun-shot, require amputation. The mortality, however, after amputation of the upper two-thirds of the thigh for gun-shot injury was so great in the Schleswig-Holstein war, that it became a question with many of the German and Danish surgeons whether this operation should be continued, or whether the patient would not have a better chance if the injury were treated as a compound fracture. At the siege of Sebastopol the mortality after amputation of the upper third of the thigh was so great in the Russian army that the surgeons abandoned the operation; nearly one-third of the cases in which the lower and middle third were amputated are said to have recovered in the British army in the Crimea (p. 43). The amputations in the upper third were fatal in the ratio of 86 per cent., those of the middle of 60, whilst of the lower third the mortality was reduced to 56 per cent. In gun-shot wounds of the joints of the lower extremity, removal of the limb becomes necessary; thus, if the head, neck, or trochanters of the femur are shattered by a bullet, it is generally considered necessary to remove the limb at the hip-joint. But Mr. Guthrie has recommended excision of the injured head and neck of the bone instead. This operation has been successfully performed by Mr. O'Leary in the Crimean war. In those cases in which the knee or ankle-joints are perforated and smashed by balls, or in which longitudinal fractures of the tibia or femur

extend into them, amputation is imperative. In some instances, when the bones are not too much disorganized, though the joints are traversed, the limb may be preserved. In some cases of gun-shot wounds, implicating the shoulder and elbow-joints, removal of splinters and excision of the injured portions of bone may be advantageously substituted for amputation, the injury in the soft parts being treated on ordinary principles, as in the case represented in Fig. 59, of a bullet lodged in the head of the humerus. The value of excision of joints in cases of gun-shot injury has been established by the experience of German, French, British, and Russian surgeons, during the recent wars on the Continent and in the Crimea. It is especially in gun-shot injuries of the shoulder and elbow-joints that these operations have been attended by satisfactory results. M. Baudens states that he saved 13 out of 14 cases of excision of the shoulder. According to Mr. Thornton, in the British army in the Crimea, the shoulder was excised 12 times with 2 deaths; the elbow in 17 cases, of which 2 were fatal, and partially in 5 other cases, all of which were successful. These results, which reflect the highest credit on the skill of our army surgeons, were more successful than those that followed the amputation of corresponding parts. Of 66 disarticulations at the shoulder, 19 were fatal; and of 153 amputations of the arm, 29 died. In the lower extremity excisions are not so successful after gun-shot injuries as for disease. Of 6 cases in which the head of the femur was excised, only 1 case, Mr. O'Leary's, recovered; and in 2 cases in which portions of the femur were removed, and in 1 in which the knee-joint was excised, death ensued.

Fig. 59.

In the Russian army conservative surgery was also extensively practised, and in it, according to Messrs. Mouat and Wyatt's Report, of 20 cases of excision of the elbow, 15 recovered.

Gun-shot wounds of the foot, if serious, require its removal, either at or above the ankle. Those of the hand are of special interest from their frequency, in consequence of the bursting of guns, or of powder-flask explosions. In these cases, however extensive the injury may be that is inflicted upon the hand, fingers being blown away, the thumb thrown back, and the metacarpal bones splintered, we must endeavor, if possible, to save a portion of it, if it be only one or two fingers; and, owing to the great reparative power possessed by the hand, we shall often, in the worst-looking cases, be able to accomplish this. If the thumb, with one finger as an opponent, can be preserved, it will be of more service to the patient than any artificial contrivance, however ingeniously made (Fig. 16). It not unfrequently happens that amputation may be required in the more advanced stages of gun-shot injury, in consequence of mortification supervening. Under these circumstances, it must be practised without delay, and without waiting for the line of separation. If, in consequence of long-continued suffering and discharge, the patient's health becomes worn out, and the limb remains a useless appendage, amputation will at last be imperative.

The question as to the period at which amputation ought to be performed after the infliction of these wounds, is one of great importance, and has given rise to a corresponding amount of discussion among surgeons. The older military surgeons, Wiseman, Ledran, Ranby, &c., taking a common-sense view of the question, advocated the removal of the hopelessly-injured limb so soon as the shock to the system had subsided, the pulse had regained its volume, and the warmth of surface had returned. After the Battle of Fontenoy, in the middle of the last century, professional opinion underwent a change upon this subject, and Faure wrote a thesis, which obtained the prize of the French Academy of

Surgery, recommending delay in amputating in certain cases. Hunter, Percy, and other surgeons of repute, promulgated similar views, until Bilguer, the surgeon-in-chief to Frederic the Great's armies, went to the absurd and dangerous extent of condemning amputation entirely. These extreme opinions necessarily occasioned a reaction, and the experience gained in the wars of the French Revolution and Empire, has finally enabled surgeons to settle this question definitely. It is more particularly by the labors and observations of John Bell, Larrey, Thomson, Guthrie, S. Cooper, and Hennen, that the necessity of having recourse to immediate amputation in all cases of gun-shot injury, requiring this operation, has been established.

In determining this point we must be guided, partly by surgical experience on the result of such cases left to nature, and partly by an appeal to facts. In appealing to experience we must, to use the forcible language of Sir Charles Bell, contemplate what shall be the condition of the parts in twelve hours, in six days, and in three months: "In twelve hours the inflammation, pain and tension of the whole limb, the inflamed countenance, the brilliant eye, the sleepless and restless condition, declare the impression the injury is making on the limb and on the constitutional powers. In six days, the limb from the groin to the toe, or from the shoulder to the finger, is swollen to half the size of the body; a violent phlegmonous inflammation pervades the whole; serous effusion has taken place in the whole limb, and abscesses are forming in the great beds of cellular texture throughout the whole extent of the extremity. In three months, if the patient has labored through the agony, the bones are carious; the abscesses are interminable sinuses; the limb is undermined and everywhere unsound, and the constitutional strength ebbs to the lowest degree."

If we appeal to facts, we shall find that of 300 secondary amputations reported by Faure, after the battle of Fontenoy, only 30 were successful; whereas Larrey saved three-fourths of his primary amputations. In the Peninsular War, the comparative loss after secondary amputations of the upper extremity was, to that following the primary, as twelve to one; and of the lower extremity, the loss after secondary amputation was three times as great as after primary. During the siege of Sebastopol, out of 80,000 wounded Russians there were 3000 amputations. Of the primary amputations of the upper extremity, leg, and foot, about one-half recovered; and of the lower and middle third of the thigh, about two-thirds died; but of all the secondary amputations more than two-thirds died. Primary amputation, therefore, should always be performed. But if an unsuccessful attempt at the preservation of the limb be made, and if occasion for its subsequent removal should arise, the surgeon must wait until suppuration has set in before he operates, the period of acute inflammatory action being allowed to pass by. The cases that most commonly require secondary amputation, are those in which traumatic gangrene has set in; here the limb must always be removed without delay, in accordance with the principles laid down in speaking of this subject in reference to contused wounds. If profuse hemorrhage occur from the wound that does not admit of suppression by the ordinary means, secondary amputation may become necessary. So, also, when the bones do not unite, the patient being worn out by discharges and the irritation of necrosis and caries, and left with a wasted, shattered, and useless limb, its removal is the only means of saving life.

CHAPTER VIII.

PUNCTURED AND POISONED WOUNDS.

PUNCTURED wounds, made by narrow sharp-pointed instruments, vary greatly in extent, from the prick of a needle in the finger to a sword-thrust through the body. Not unfrequently punctured wounds are somewhat contused, being made by a triangular or wedge-like weapon, as a bayonet or lance blade. Hence they partake of the general character of contused wounds, having a tendency to unite by granulations from the bottom, and to be accompanied by much inflammatory fever. When deep, they are of a most dangerous character—wounding blood-vessels, traversing the great cavities, and injuring the contained viscera.

In the treatment of punctured wounds, the principal points are to arrest the hemorrhage, and to facilitate union.

The hemorrhage must be arrested by pressure properly applied by means of compresses or pads, so as to approximate the sides of the puncture; by the application of cold; or by cutting down on the injured vessel if it be a large one, and ligaturing it above and below the perforation in it.

In the majority of cases, unless the injury be a slight one, suppuration and union by the second-intention will take place. This must be promoted by poulticing; and undue inflammation must be guarded against by local antiphlogistics. In many cases union by adhesion is obtained: and in others that are allowed to suppurate, there can be little doubt that the same favorable termination might be secured if proper attention were paid to the injury. In former days when duels with the small sword were of frequent occurrence, persons called "suckers," who were often the drummers of a regiment, were employed to attend the wounded combatant. Their treatment, which was conducted with a certain degree of mystery, consisted in sucking the wound till all blood ceased to flow; then applying a pellet of chewed paper or a piece of wet linen to the orifice; in this way it would appear that many sword-thrusts traversing the limbs were healed in a few hours or days. The process of suction cleared the wound thoroughly of all blood, and drawing the sides into close apposition, placed the parts in the most favorable condition possible for union by adhesion. This practice might, perhaps, in many cases, be advantageously imitated at the present day with a cupping-glass and syringe.

FIG. 60.

Amongst the varieties of punctured wounds that are most commonly met with in ordinary practice, are those that are occasioned by needles penetrating into, and breaking off in the body. These accidents chiefly occur in the fingers and about the nates, and though of a trivial character, are often extremely troublesome, both to surgeon and patient. When the surgeon is called shortly after the occurrence of the accident, he must endeavor to remove the fragment left behind, by cutting down upon it. In doing this he will be guided by the situation of the puncture, and by the seat of the pain, and sometimes by feeling the point projecting under the skin. In many cases this is a sufficiently simple proceeding; in others, however, a deep and troublesome dissection may be required, especially when the fragment of needle gets into or under the sheaths of a tendon. I have had occasion to undertake somewhat troublesome dissections between the biceps tendon and the brachial artery, or in the close proximity of the ulnar artery, for

the removal of fragments of needles lodged in the bend of the arm and the wrist. For the purpose of extracting needles, thorns, splinters of wood, and other foreign bodies of small size and pointed shape lying in narrow wounds, the forceps shown in the annexed woodcut (fig. 60) will be found most serviceable, as they have very fine, but strong and well-serrated points.

In many cases if the needle have been lodged for some days, the surgeon will fail in his endeavors to extract it; and unless the indications of its presence be very clear, I think the wiser course is to leave it undisturbed, and to trust to nature for its elimination from the body, as it will seldom be found when sought for, and indeed, may not exist, although supposed to be present. The following plan of ascertaining whether a portion of needle be really impacted has been suggested by Mr. Marshall. A powerful magnet is to be held upon the part for a quarter of an hour, so as to influence the fragment; a finely-hung polarized needle should then be suspended over it, when if any iron be present, deflexion will ensue.

POISONED WOUNDS.

A very important variety of punctured wound is that in which a poison is introduced into the puncture. The most important of these poisoned wounds are those inflicted by the stings of insects, the bites of snakes or of rabid animals, and injuries received in dissection.

The *stings of insects*, as of bees, wasps, &c., though painful, seldom produce any serious inconvenience; yet occasionally they may do so, and even prove fatal, by inducing erysipelas in some unhealthy constitutions, or by giving rise to intense irritation by the multiplicity of the stings; as by bees swarming upon and stinging a person in great numbers; or they may be dangerous in consequence of an important part being stung, as the eye, or the interior of the mouth, or pharynx, as has happened by swallowing a bee in a piece of honeycomb. Some insects, as scorpions or the tarantula in Italy, give rise to serious and even fatal disturbance by their bite. A peculiar train of nervous phenomena is said to follow the bite of the tarantula, hence called "tarentismus," a disease that is generally stated to be peculiarly influenced by music, though this has recently been denied by M. Gozzo.

In the treatment of stings of insects the application of cooling lotions, of a cold poultice, or rubbing the part with olive oil, will be found the most useful means of allaying irritation. In some cases, touching the part stung with ammonia, gives immediate relief.

Snake bites are seldom fatal in this country, venomous reptiles, such as the viper and adder, not possessing a sufficiently energetic poison to destroy a healthy adult, though they might possibly kill a child or a very delicate and weakly person. They are said to be most active in warm weather and during the season of procreation, and their bites are most dangerous if inflicted through a vein or glandular part, or near the centre of the circulation, or about the neck and face. In tropical countries the bite of the rattle-snake, of the Cobra di Capella, the puff-adder, or the Tobacco-pipe snake is often fatal; and it occasionally happens in this country that the surgeon has an opportunity of seeing wounds inflicted by these fearful reptiles in menageries. Thus Sir E. Home has recorded a fatal case of rattle-snake bite occurring in this country. A similar instance lately occurred at St. George's Hospital, and another in Paris, to showmen. The most remarkable case of this kind with which I am acquainted occurred recently at the University College Hospital, affording an opportunity, rare in this country, of witnessing the effects of the bite of a Cobra di Capella. The patient, a keeper at the Zoological Gardens, was bitten in the bridge of the nose, the poison fang having apparently penetrated the angular vein. When brought to the hospital, about half an hour after the accident, he was apparently

dying, being unable to speak, swallow, or support himself; the pupils were dilated, face livid, heart's action feeble, and he was scarcely conscious. After death, which took place in little more than an hour from the time of the infliction of the wound, the veins of the brain and the cerebral sinuses were found congested with blood, as were also the lungs to an immense extent, and the solid abdominal viscera. The right cavities of the heart were loaded with dark blood, the left being empty; indeed the phenomena of asphyxia were strikingly marked. In this case death would appear to have resulted from the poison paralyzing the medulla oblongata, and those portions of the nervous system that are instrumental in carrying on respiration, at the same time that the blood was disorganized by the action of the virus.

Snake-poison when introduced into the system may kill in two ways; either by its direct depressing influence, somewhat resembling that produced by some narcotic poisons; or, by exciting a kind of diffuse inflammation of the cellular tissue of the limb or part.

The first mode of death only occurs when the poison is either very powerful, or the animal bitten small. Thus the poison of the Tobacco-pipe snake is said to be so virulent that it will kill a full-grown man in less than a quarter of an hour. The rattle-snake, and the Cobra di Capella, will kill a small animal in the course of a few seconds; and a man lately bitten by a rattlesnake in Paris, died in nine hours; the Cobra bite just related was fatal in less than one hour.

In other cases again, the poison acts by exciting diffuse inflammation, suppuration, &c., of the cellular tissue. Thus in the case which occurred in St. George's, the patient died on the 18th day after the bite of a rattlesnake, with large abscesses in the arm and in the axilla, and with sloughing of the cellular tissue of the limb.

The *symptoms* occurring after a poisonous snake-bite, consist in great depression and prostration of the system, a feeble and intermittent pulse, dilated pupils, usually slight delirium, speedy stupor, insensibility, and death. The part bitten swells and becomes livid in a few hours; and, if the patient survive sufficiently long, diffuse inflammation and gangrene occur in its neighborhood; involuntary evacuations take place; asthenic symptoms set in, which may eventually terminate fatally in the way that has already been mentioned, or end slowly, and after a lapse of time, in the recovery of the patient, whose health may long suffer seriously from the effects of the accident.

The *treatment* of these injuries is local and general.

The *local treatment* presents two great indications: 1stly, to prevent the absorption of the poison into the system; and 2dly, to treat the diffuse inflammation and sloughing that may subsequently occur. The first indication may be fulfilled by tying a ligature so tightly round the limb at a little distance above the injured part as to arrest all circulation through it. In this way the absorption of the poison may be prevented; the wound should then be freely cauterized with a red-hot iron or cinder, or better still, be excised, and a cupping-glass applied over the cut surface, so as to withdraw the blood in the neighborhood which may have become contaminated by the poison. If a cupping-glass be not at hand, or if the part bitten be so situated as not to admit of its application, there can be no objection to the employment of suction by the mouth after free excision; the poison not being absorbed by an unbroken mucous membrane. In using suction, the mouth should be rinsed with brandy. With the view of lessening the swelling, tension, and pain of the limb, frictions with olive oil are said to be advantageous. After diffuse inflammation has set in this must be treated on general principles — by fomentations and free incision.

The *constitutional treatment* consists in the early and free administration of the most powerful stimulants, with the view of combating the depression that exists. For this purpose, brandy, wine, ammonia, or ether must be freely given.

The eau de luce—which enjoys a high reputation in some tropical countries—owes its efficacy to the ammonia which it contains. Should drowsiness come on, the patient must be walked about, and artificial respiration with galvanism may be resorted to as a last means of maintaining life until the effects of the stimulants may overcome those of the poison. Large doses of arsenic have been recommended as a kind of specific, and the "Tanjore pill," a celebrated Indian remedy, owes its activity to this mineral; but care must, of course, be taken in administering this, lest the remedy prove as fatal as the injury for which it is administered.

[The experiments recently made by Dr. Hammond, U. S. A., and Mr. De Vesey, of California, as to the prophylactic and curative powers of Bibron's antidote to the bite of the rattlesnake seem to go far to prove its efficacy. As this subject is one so pregnant with interest to the American surgeon, we give the formula in detail, as furnished to Mr. De Vesey, by Prince Paul, of Wurtemburg, the celebrated naturalist: "℞. Potassii Iodidi, gr. iv.; Hydrarg. chloridi corrosiv., gr. ij; bromini, ʒv. — M. Ten drops of this mixture diluted with a tablespoonful or two of wine or brandy, constitute a dose; to be repeated if necessary. It must be kept in glass stoppered vials well secured."

In two or three cases in which the antidote was administered to the human subject, when bitten by the serpent, an almost immediate amelioration of the symptoms was experienced; and in the series of experiments practised upon dogs the results appeared to be satisfactory. — Vide the *American Journal of the Medical Sciences for January and April*, 1858.]

The *bite of rabid animals* gives rise to the disease so much dreaded and so often spoken of, but fortunately so seldom seen in man in this country, termed *hydrophobia.*

This disease invariably occurs in man, and, most commonly, in the lower animals, as the result of contagion. The wolf, the fox, the jackal, and the cat are most liable to it. When originating *de novo*, its causes are excessively obscure. It has been attributed to the influence of season; thus Eckel finds it most common in the months of February and May; but want of water, sudden changes from heat to cold, bad food, and unsatisfied sexual desires have all been assigned as causes of its occurrence in animals. Dogs more frequently become rabid than bitches; thus, of a hundred and forty-one cases collected by Eckel, only fifteen occurred in bitches; and amongst dogs it is most common in those of a mongrel breed, seldom affecting those that are of pure blood; or that have been castrated. In the human subject it never appears except as the result of contagion either by a bite, or by the rabid animal licking a raw surface, as an abrasion on the hand or lip. The bite of a rabid animal is most dangerous when inflicted on a naked part, as on the hand or face. A person bitten through clothing often escapes any ill effects, in consequence of the teeth being wiped and the poisonous saliva arrested by the clothes. Hence a number of persons may be bitten by the same rabid animal, and but a very few take the disease; not more, perhaps, than one in ten, or one in twenty.

The period that intervenes between the bite and the occurrence of the disease is usually considerable. Meade has related the case of a lady who got the disease fifteen months after the bite. Elliotson says that the average time that elapses between the injury and the symptoms is from six weeks to three months. The Duke of Richmond, who was bitten by a tame fox, took the disease between six and seven weeks after the injury. Writers, however, in stating that six, seven, twelve, and even fifteen years have intervened between the infliction of the wound and the manifestation of the symptoms, have evidently committed an exaggeration or fallen into error, having very probably confounded other nervous affections that closely resemble hydrophobia with it.

Symptoms.—The wound has generally cicatrized long before any symptoms

of hydrophobia declare themselves, and no peculiar appearance is presented by the scar. Shooting pains, twitching and itching sensations have, however, occasionally been experienced in the site of the wound before the supervention of the attack; and it is probable that in all cases some process analogous to a zymotic action takes place within it before the disease comes on. The precise nature of this, however, requires to be elucidated by further observation.

The general symptoms are usually ushered in by some antecedent phenomena for two or three days; according to Perry, for five or six. These initiatory symptoms consist of giddiness, chills, and heats, and a general feeling of discomfort. The more special symptoms never manifest themselves until the disease becomes fairly established; they consist of extreme nervous irritability and apprehension, with convulsions, induced by various external influences, whether acting on the surface of the body, or on the fauces, or may be occasioned by mental impressions, and speedily end in exhaustion and death. These more special symptoms may be arranged under three heads: consisting of a spasmodic affection of the muscles of deglutition and respiration; of extreme sensibility of the surface and of the senses; and of excessive mental terror and agitation.

In consequence of the spasmodic affection of the muscles of deglutition, the act of swallowing commonly excites convulsions; hence the patient experiences a horror of all liquids; and, in attempting to drink, gulps down the fluid with a strong mental effort. In some cases, solids give rise to the same difficulty in deglutition as liquids; but occasionally, though rarely, patients have been known to swallow perfectly well throughout the disease. This difficulty in swallowing is certainly owing to an excessive sensibility about the pharynx and throat, in consequence of which every effort at deglutition induces violent reflex movements.

A catch in the breathing, resembling what often occurs when a person goes into a cold bath, is met with as one of the earlier symptoms, taking place in the midst of conversation, and before the patient's mind is directed to the nature of the disease. This catch is due to the spasmodic descent of the diaphragm, and gives rise to severe pain at the pit of the stomach, or a feeling of suffocation, and a return of the convulsions.

An extreme degree of sensibility of the surface, and of some of the senses, is characteristic of hydrophobia. The cutaneous nerves become so sensitive that a blast of cold air, the rustling of the bed-clothes, the slightest touch of or movement on the skin will bring on convulsions. The nerves of sense become equally excitable, so that a sudden flash of light before the eyes, as the reflection of the sun from a looking-glass, or a sudden noise, as the slamming of a door, will produce the same effect. The noise produced by liquids being poured from one vessel to another is peculiarly distressing to the patient; and Dr. Elliotson mentions a patient with hydrophobia being thrown into violent agitation by hearing the dresser, who sat up with him, make water.

The sufferings and convulsions that patients experience when they attempt to drink, appear to be owing to this excessive sensibility of the nerves of the mouth and pharynx, and the recollection of these sufferings makes them afraid to repeat the attempt; hence the fear of liquids, from which the disease derives its name.

One of the earliest symptoms of hydrophobia, and one of the most persistent, is an extreme degree of mental agitation and terror, a vague sense of dread and horror at the impending fate. Delusion sometimes occurs of a spectral character, the patient supposing himself to be surrounded by animals, by horrid forms, or by gaping, ghastly, and grinning countenances. The first symptom in the Duke of Richmond's case was, that he fancied some poplar trees opposite his bed-room window were men looking in. These delusions may alternate with fits of delirium and frenzy. In these it is said that the patient barks like

a dog, and endeavors to bite; but this is a popular error — the pretended bark is merely the catch in breathing, and the attempt to bite is nothing but movements of the tongue and mouth, induced by the clamminess of the viscid and ropy mucous saliva. Occasionally the symptoms subside completely before death; the sensibility of the surface disappearing, the mental agitation or delusion being removed, and deglutition and respiration being quietly performed. Thus Dr. Latham relates the case of a man laboring under this disease, who sat up quietly in bed, and drank a pint of porter half an hour before he died.

I am not acquainted with any authentic case of recovery from hydrophobia, after the disease has fairly set in. The disease may prove fatal in four-and-twenty hours, or life may be prolonged for six or seven days; death generally occurring from the second to the fourth day, and being apparently induced by exhaustion.

The appearances found after death throw no light whatever upon the disease, and indeed may often be supposed to be the effects rather than the causes of the spasmodic irritation. The tongue, the fauces, the throat, the glottis, and the larynx, the stomach and œsophagus, the brain, the medulla oblongata, and spinal cord, have all been found congested and inflamed; there is nothing, however, in the appearances presented by these parts that affords a clue to the true nature of this inscrutable and terrible malady.

The *treatment* must principally be of a preventive and palliative character; we cannot speak of *curative* treatment in hydrophobia; for, after the disease has once set in, the utmost that can be done will not accomplish more than to lessen the sufferings of the patient, and stay for a few hours the fatal termination.

When a person is bitten by a dog that is mad, or even by one that is supposed to be so, the surgeon should always adopt energetic means to save the patient from the invasion of a disease that is necessarily fatal. In having recourse to preventive treatment, it should be borne in mind that the larger proportion of persons actually bitten by rabid animals do not fall victims to hydrophobia; the probability of the occurrence of the disease depending partly upon the animal that bites, and partly upon whether the bite is inflicted upon the naked or clothed parts of the body. Thus Watson states that, of 114 persons bitten by mad wolves, 67 died of hydrophobia; whilst, according to Hunter and Vaughan, only 1 out of 20 or 30 bitten by mad dogs take the disease. This latter estimate may possibly be somewhat lower than the truth, but yet the fact remains certain that wolf-bites are far more dangerous than dog-bites, and this is probably owing to the circumstance of wolves always flying at the face and naked parts. It is in consequence of this small proportion of persons taking the disease out of the total number bitten, that so many popular remedies and superstitions have obtained an unmerited reputation for preventing the disease. The only preventive means that can be trusted to by a surgeon are, excision and caustic.

Excision of the part bitten should be carefully and freely performed — no half measures being had recourse to. Hence it is better to remove too much of a comparatively unimportant tissue or part, than to allow the sufferer to run any risk of falling a victim to this fatal disease. In order to excise every part that has been touched by the tooth, the surgeon, after washing the wound and contiguous surface, should make a circle with ink, or tincture of iodine, completely round the injured part. He must then pass a probe to the bottom of the wound, and excise the whole by scooping out a conical piece of the tissues, taking care to go beyond the furthest limit to which the probe is passed. If there be any doubt of the whole of the injured parts having been removed, potassa fusa should be applied. If the lip is bitten through, a portion should be cut out, and the wound brought together, as in hare-lip operations; if it be

a finger that is injured, amputation of it should be performed. In those cases in which the wound is so situated that excision cannot readily be performed, potassa fusa, or strong nitric acid, or nitrate of silver, as recommended by Mr. Youatt, should be freely applied to every corner of it.

If the bite have already cicatrized, the place should be excised at any time after the injury, provided the dog is known to have been, or to have become mad, for it is not improbable that the occurrence of some of the remoter cases of the disease is dependent upon, or connected with, some peculiar action set up in the wound, which might possibly be averted by the removal of the cicatrix. I forbear to speak of any other means of preventive treatment than excision and caustic, as I consider them utterly undeserving of confidence.

After the disease has once set in, nothing can be done but to palliate symptoms and to prolong life. Every possible remedy that the ingenuity of man could devise, from warm water to viper and ticuna-poison, has been tried, and been found utterly useless. The only plan of treatment that holds out a hope of eventual success, and which, whether it succeed or not in curing the patient, at all events mitigates his sufferings, is that which has been recommended by Drs. Marshall Hall and Todd. It consists, in the first place, in removing all external irritation, whether mental or bodily; putting the patient in a darkened room, as much removed as possible from all noise and the intrusive curiosity of strangers, and surrounding his bed with gauze curtains or screens, so as to prevent the disturbing influence even of a draught of cold air. Measures must then be adopted to lessen the excitability of the spinal cord. This may be done most efficiently, as Dr. Todd suggests, by the application of ice in a piece of gut laid along the whole length of the spine, and, lastly, the surgeon must bear in mind that he has to treat an exhausting disease, and that he must consequently support the patient by wine, beef-tea, and such nourishment as can be taken.

Dissection-wounds.—The majority of wounds received in dissection are not dangerous. Every student in anatomy frequently punctures and cuts himself in dissecting in the course of his studies, and it is but rarely that we see any ill consequences following these injuries. In some cases, however, the most serious results, terminating in permanently impaired health, or even in death, ensue. The result depends partly on the state of health of the person punctured, and partly on the condition of the body from which the puncture is received. If the health be broken by any cause, whether excess of study or dissipation, very serious effects may follow that would not occur if the patient had more resisting power; hence it is of much importance to those engaged in the practical study of anatomy not to allow the health to become impaired to too great an extent.

The deleterious influence exercised by the dead body may be attributed to three different causes. Thus it may be supposed to result from the mere ordinary irritation of the wound; or, it may arise from the inoculation of putrid matter; or, lastly, be dependent upon the introduction of a specific virus into the system. I think it is probable that each of these causes may exercise an influence, but that the worst effects of dissection wounds are dependent on the inoculation of a peculiar virus.

That ill effects sometimes result from the simple irritation of the puncture is evident from the fact, that we see mere scratches or punctures with splinters of wood, or other harmless substances, give rise to considerable local disturbance in certain states of the constitution; so also we find that those dissection-wounds that are ragged and torn, such as are made by spiculæ of bone or the tooth of a saw, are attended by peculiarly troublesome consequences.

Putrescent matters must always be injurious when introduced into the economy, but, at the same time, it is a remarkable fact, that the worst dissection-wounds have been received before putrefaction had set in, and that they

more commonly occur in post-mortem inspections than in dissecting-room investigations.

That the worst forms of dissection-wounds are dependent upon a specific virus is evident from the fact, that it is especially after death from certain diseases, especially of an erysipelatous type, that these consequences ensue. Most danger is to be apprehended from punctures received from the bodies of those who die of erysipelas, phlebitis, and the diffuse forms of peritonitis following parturition or the operation for hernia. That the poisonous influence from such bodies is transmissible to others by contact or infection, cannot be denied, and such accoucheurs and operating surgeons should abstain as carefully as possible from performing post-mortem examinations on patients dying from such diseases, lest the poisonous influence be carried to and excite similar morbid action on their own patients. The mere contact of such a body is occasionally dangerous. Thus, I have known a subject in the dissecting-room seriously infect in different ways six students who were working at it. Two had suppuration of the cellular tissue, under the pectorals and in the axilla; one was seized with a kind of a maniacal delirium; a fourth had typhoid fever; and the remaining two were seriously, though not dangerously, indisposed.

From all this it would appear that there are two distinct kinds of mischief resulting from these injuries.

The milder form is not of a specific character, but proceeds from the simple irritation of a scratch in a broken constitution, or from the inoculation of putrescent matter. In these cases the part punctured becomes painful, hot, and throbbing, in from twelve to twenty-four hours after the injury, the finger swells and inflames, the absorbents of the arm are perhaps affected, and the glands in the axilla become enlarged. There is general febrile disturbance of an inflammatory character, ushered in by rigors, and a feeling of depression; suppuration takes place about the puncture, and also, perhaps, in the inflamed glands, the case presenting the ordinary characters of whitlow with inflammation of the absorbents.

In the more severe form of dissection-wound, the patient is seized, about twelve or eighteen hours after the puncture, with rigors, anxiety of countenance, and depression of the nervous system: with a quick pulse, and with febrile reaction of an inflammatory character; on examining the finger, a pustule, or vesicle, with an inflamed areola, will be observed in the situation of the puncture; from this a few red lines may be observed stretching up towards the arm-pits, with swelling and tension in this region. Diffuse inflammation of the cellular tissue of the limb sets in about the fifth or sixth day, extending up to the shoulder, and down the side of the chest to the flank. Abscesses, usually of a somewhat diffuse character, the pus being mixed with shreds and sloughs, form, often with much pain, in these situations. The general symptoms gradually assume an asthenic type; the tongue becomes brown, sordes accumulate about the lips and gums, low delirium sets in with a rapid, feeble pulse, and death occurs in from ten days to three weeks. When incisions are made into the brawny tissue, it is found infiltrated with sero-pus, and in a sloughy state. If the patient live, large circumscribed abscesses form under the pectorals, in the axilla, and above the clavicle, with much exhaustion and depression of the system, convalescence being tedious and prolonged, and the constitution being often shattered for life.

It is this form of the disease that resembles diffuse inflammation of the cellular tissue arising from other causes; and indeed there can be little doubt that it is a cellular erysipelas dependent on a toxic agency. That this form of dissection-wound is of a truly erysipelatous character, is evident from the fact, that patients laboring under it will communicate fatal erysipelas to their nurses and attendants; as happened in the case of the late Mr. Potter, whose early death is so much to be lamented. It is also this kind of dissection-wound that

is especially apt to occur after punctures received from patients who have died of diffuse inflammation of the serous membranes.

Treatment. — On the receipt of a puncture in dissection, the best mode to prevent injurious consequences, is, to tie a string tightly round the finger above the injury, thus causing the blood to flow, and perhaps to wash out the virus with it. The part should then be well-washed in a stream of cold water at a tap, and sucked for some minutes; in this way any poisonous matter that has been introduced may usually be got rid of. I think that, in general, it is better not to apply caustics in these cases; they only irritate and inflame the finger, and can do but little good. If any caustic be employed, it should be a drop of nitric acid let fall into the wound. The nitrate of silver, which is commonly employed, can never do much good, as it does not penetrate to a sufficient depth to be of service. Dissectors should bear in mind the great influence that the state of the constitution exercises upon the effects of the puncture, and that in proportion as the health is sound there is less likelihood of any injurious consequences ensuing.

In the slighter forms of dissection-wound, attended by a moderate amount of inflammation, the part must be poulticed, leeches should be applied, and the arm put in a sling. If the absorbents become inflamed, chamomile and poppy fomentations must be diligently used, the early opening of abscesses had recourse to, and free incisions should be practised wherever there is much tension, even though matter have not already formed, with a view to prevent suppuration. The general treatment of clearing out the bowels with a free calomel purge, followed by moderate antiphlogistics in the early stages must be adopted; but support will soon be required; and if there be much constitutional irritation, opiates may advantageously be administered.

The treatment of the more severe forms of dissection-injury consists principally in fomentations, and in early and very free incisions into the finger or other parts that become tense and brawny. In the constitutional treatment our great reliance, after clearing out the intestinal canal with a free purge, such as five grains of calomel and fifteen grains of jalap, consists in the administration of bark, ammonia, camphor, wine, and brandy, with such nourishment as the patient can take; the case being treated as one of the lowest forms of asthenic inflammation. If the patient survive, he must be sent as soon as possible into the country, and must devote some months perhaps to the re-establishment of his health. The part that has been punctured often continues irritable for a great length of time, even for many years, remaining red, inflamed, and desquamating, with perhaps the occasional formation of pustules upon it. This condition is best remedied by the occasional application of the nitrate of silver.

CHAPTER IX.

INJURIES OF TISSUES AND ORGANS.

We next proceed to the consideration of injuries of particular tissues and organs, and we shall take these in the following order: 1stly. Injuries of nerves. 2dly. Of blood-vessels. 3dly. Of the organs of locomotion, including those of bones, joints, muscles, and tendons; and 4thly. Injuries as they affect particular regions of the body.

INJURIES OF NERVES.

Nerves are often contused, the injury producing a tingling sensation at their extremities, and pain at the part struck, which usually pass off in the course of a few minutes or hours; but in certain conditions of the system, more especially in the hysterical temperament, this may last for a considerable period, and even give rise to neuralgia of a more or less permanent character.

If a nerve be punctured, unpleasant consequences sometimes result, more particularly in delicate women. Thus, I have more than once seen a puncture of one of the digital branches of the ulnar nerve produce a kind of painful paralysis of its trunk, rendering the arm nearly useless. I have seen the same effects happen in the median nerve from so slight a cause as the puncture of a finger with the needle. It occasionally happens in venesection at the bend of the arm, that a branch of the internal cutaneous is pricked with the lancet, and that very persistent neuralgia occurs in consequence.

When a nerve is completely cut across, immediate paralysis of sense and motion occurs in all the parts supplied by it. Consequently, if the integrity of the nerve be essential to life, as of the pneumogastric, death must ensue.[1] There is well-marked loss in temperature and modification of nutrition in some cases of cut nerve. This is probably owing to the dilatations of the smaller arteries, and consequent slowness of circulation, that has been found in animals to follow the section of the nerve of a limb. Thus in a patient who applied at the University College Hospital twenty-one weeks after the ulnar nerve had been accidentally divided, and who had paralysis of the parts supplied by it, I found the temperature between the ring and little fingers of the injured side to be 9° Fahr. below that of the same spot on the other hand.

If a cut nerve be examined shortly after the injury, it will be found to have become slightly bulbous at the extremity, nervous matter having escaped from the neurilemma, and fibrine being thrown out and around between the two ends. Restoration of the continuity of the nerve evidently takes place, as is shown by the fact, that in the course of a few months its functions gradually become re-established in its lower part, the paralysis slowly disappearing. If, however, a portion of the nerve has been actually excised, there is no restoration of function, as was shown long ago by Haighton. Schwann and Hasse have found the return of sensibility and motion in the lower part of the nerve to be owing to nerve-tubes forming in the uniting medium, and thus serving to establish the continuity of the nerve.

CUTS AND WOUNDS OF BLOOD-VESSELS, AND HEMORRHAGE.

The characters of the bleeding or hemorrhage differ according to the nature of the vessel from which the blood escapes. When a vein is wounded, the blood that is poured out is of a dark color, and flows in a uniform stream; the force with which this is projected depending on the conditions in which the wounded vein is placed. If there be any pressure between the wound and the heart, as of a ligature upon the vessel; or if the position of a part be such as to favor the gravitation of the blood towards the wound; or if the muscles of the limb be made to contract, the force of the flow of blood will be increased.

[1] [That division of the pneumogastric nerve does not necessarily result fatally, is proved by a case reported by Dr. J. H. B. M'Clellan, of this city. In an operation for the removal of the parotid gland, Dr. M'Clellan found the nerve in question involved in the diseased mass, as well also as the spinal accessory and portio dura. The tumor was excised, and with it a portion of the pneumogastric, two inches in length. Strange to say, scarcely any impediment to respiration was experienced, and the patient recovered.

To the best of our knowledge no other such instance is on record, but the case adduced proves beyond all doubt, that in the living subject, the important functions of this pair of nerves may be executed fully by one alone. Vide *M'Clellan's Surgery*, p. 336.]

When an artery is wounded, the blood that escapes is of a bright vermilion or scarlet color. It flows by jets, synchronous with the contractions of the left ventricle; and between each jet the flow does not cease, but the stream becomes continuous. In the great majority of cases the jet only comes from the proximal aperture, dark blood issuing from the distal opening in a continuous and trickling stream; but in some situations a jet of blood, of an arterial character, may issue from the distal as well as the proximal end of the cut vessel, as in wounds of the palmar and plantar arches, or of the arteries of the forearm. As the blood flows the jet lessens in height, in consequence of the weakening of the heart's action. The height and force of the jet in all cases depend greatly on the size of the vessel; thus the jet from the femoral artery is stronger than that from a muscular branch of the thigh. When a small arterial branch is wounded near to its origin from the main trunk, the jet will always be forcible and free; so also the proximity to the centre of the circulation will influence materially the force with which the blood is propelled from the wound in the vessel.

When the blood is not poured out on the surface, but escapes from a wounded vessel into the cellular tissue of a part, the substance of organs, or internal cavities, it is termed an *extravasation*. In these cases there are not the ordinary local signs of hemorrhage, but we judge of the escape of blood by the general effect produced upon the system by its loss.

The *constitutional effects of hemorrhage* depend upon the quantity of blood lost, on the rapidity with which it is poured out, and on the state of the patient's constitution.

When a large quantity of blood is suddenly lost, as when a main artery is cut across or an aneurism bursts, the patient may die forthwith; falling down in a state of syncope, with a pale cold surface, lividity about the lips and eyes, and a few gasps, sighs, great restlessness, and convulsive movements of the limbs before he expires. If the quantity lost be not so great as to produce death, but is yet very considerable, the patient becomes faint and sick, with coldness and pallor of the surface, great restlessness and agitation, thirst, noises in the ears, and failure or complete loss of sight. If the quantity lost, though considerable, be not so great as this, or be spread over a greater interval of time, so that the patient is enabled to rally between the recurrences of the hemorrhage, a state of anemia will be induced, characterized by pallor of the skin and of the mucous membranes, palpitation of the heart, rushing noises in the head, amaurosis, a tendency to syncope when in the erect position, œdema of the extremities, and general debility of the system.

After excessive loss of blood, the patient may gradually rally, and, as the vital fluid is reproduced in his system, he may recover without any bad effects; or he may fall into a state of anemia, which may perhaps never be completely recovered from, and be associated with various forms of local debility and disturbance of functions. After very abundant loss of blood, "hemorrhagic fever" is apt to set in, characterized by a tendency to reaction in the system, with extreme irritability of the heart and arteries. It is irritative fever conjoined with anemia. There is but a small quantity of blood in the system, and the heart and arteries make violent efforts to drive it forwards. This condition is marked by the symptoms of extreme loss of blood, alternating with periods of intermittent reaction, the pulse becoming much hurried, fluttering, jerking, and irregular in force and frequency; slight flushing of the face and brilliancy of the eyes, rapidly passing again into pallor and syncope; and if the hemorrhage eventually prove fatal, delirium and convulsions, with excessive restlessness, usually precede death. The body of a person who has died from the effects of hemorrhage presents a peculiarly blanched, semi-transparent, waxen look; the lips, alæ of the nose, and finger-nails, having a somewhat livid

appearance, contrasting strongly with the clear, yellowish-white hue of the general surface

The *general treatment* of hemorrhage is sufficiently simple. After the flow of blood has been arrested by proper local means, such as will hereafter be described, the effects of its loss are usually speedily recovered from by rest and good nourishment. In some cases, however, the nutrition of the system becomes permanently impaired, and a state of chronic anemia is induced, which, notwithstanding the administration of chalybeate preparations, may continue through life, and terminate in cachexia, phthisis, or diarrhœa.

When the loss of blood is considerable, and is attended by symptoms of much prostration, it may be necessary to have recourse to immediate measures, in order to prevent the syncope being fatal. With this view the patient should be laid recumbent, with the head low, and pressure may be exercised upon the abdominal aorta or the main arteries of the limbs, so as to confine the blood as much as possible to the nervous and circulatory centres. If death appear imminent from the effects of the hemorrhage, as happens in some cases of flooding, transfusion of blood may be had recourse to; the influence of which, in restoring the failing powers of the heart and nervous system, is immediate and most striking, and has been unquestionably determined by the observations of Dr. Blundell and other obstetricians.

The *operation of transfusion* is one of some delicacy, and requires care, lest mischief be occasioned by the injection of air together with the transfused blood — an accident that would probably prove fatal to the patient. If the proper transfusing apparatus, such as Higginson's or Blundell's, by which the blood may be injected without the risk of admixture of air, and of a proper temperature, be not at hand, an ordinary hydrocele syringe capable of holding about six ounces, and fitted with stop-cock and canula, may be used. An opening of sufficient size having been made in one of the larger veins at the bend of the arm or about the instep, and the canula having been introduced for about an inch, the syringe, previously warmed, should be filled, and about twelve ounces of freshly-drawn human blood slowly but steadily injected, the limb being placed in such a position as to favor its transmission to the heart. In performing this operation, the principal points to be attended to are, the proper introduction of the canula into the vein with as little injury as possible to its coats, the perfect freedom of the whole apparatus from bubbles of air, and the steady but rapid performance of the operation, so as to avoid coagulation and deterioration of the blood. If transfusion be determined on, it should not be delayed until the last moment, when the agony of death has already commenced, as then the actions of the nervous and circulatory systems may be so impaired that the patient is no longer recoverable, or if temporarily so, will speedily relapse into a state of fatal disease.

CHAPTER X.

WOUNDS OF VEINS.

Veins are very commonly wounded suicidally, accidentally, or in surgical operations, but unless they are deeply seated, their injuries are seldom attended by any serious consequences. There are, however, three sources of danger in wounds of veins: 1st, from loss of blood; 2d, from the occurrence of

diffuse inflammation of the vessel; and, 3d, from the entrance of air into the circulation.

A vein is known to be wounded when dark blood flows in a rapid and uniform stream from the seat of injury. If the vessel wounded be one of considerable magnitude, or be in close proximity to the centre of the circulation, the flow of blood may be rapidly fatal, more especially if its escape is favored by the dependent position of the part.

The hemorrhage from a wounded vein may, if the vessel is superficial, be arrested by position, and the pressure of a compress, by means of a few turns of a roller. If the vein be one of considerable magnitude, as the internal jugular, for instance, or if it be so situated that pressure cannot be brought to bear upon it, it may require the application of a ligature: this, however, should, if possible, always be avoided, inasmuch as it is apt to occasion dangerous inflammation of the vessel.

The wound in a vein is healed by slight inflammation taking place about the lips of the incision, and giving rise to the formation of a distinct cicatrix. In some cases, from the irritation of the simple wound, and in others from the application of the ligature, a diffuse form of inflammation of the vein takes place, which usually proves fatal. This variety of phlebitis will be described when we come to speak of the different kinds of venous inflammation.

The *entrance of air into a wounded vein*, though an accident of rare occurrence, is one that occasions such peculiar and alarming symptoms, that it becomes necessary to be acquainted with the circumstances attending it; and its study is the more interesting to the practical surgeon, as it is chiefly in the course of operations that this condition occurs.

It has long been known to physiologists that the forcible introduction of air into the circulation would kill an animal; and Morgagni, Valsalva, Bichat, and Nysten, have made this a subject of observation and experiment. The death of the animal in these cases appears to be dependent partly upon the quantity of air injected, and partly on the rapidity with which it is thrown in. Bichat supposed that a single bubble injected into the circulation killed the animal with the rapidity of lightning; but this is erroneous, as shown by Nysten. I have on several occasions injected two or three cubic inches of air into the jugular vein of a dog without producing death, though much distress resulted. The rapidity with which the air is thrown in exercises a considerable influence upon the result. If blown in quickly, a small quantity may kill; if thrown in slowly and gradually, a large quantity may be injected without destroying life, the blood appearing to dissolve and carry away the gaseous fluid.

In surgical practice, we do not meet with the forcible introduction of air, but have only to do with its *spontaneous admission* into the circulation. This was first observed in the year 1818, in a case in which the internal jugular vein was opened during the removal of a large tumor from the right shoulder by M. Beauchesne. The investigation of this subject is consequently a comparatively recent matter, in which the labors of the Commissioners of the French Academy are conspicuous, and the names of Magendie, Amussat, Cormack, and Wattman, are distinguished. As cases of the entry of air into the veins comparatively seldom occur in man, it is necessary to study the phenomena accompanying it, on the lower animals. In experiments which I have made on this subject, I have observed the following phenomena:—On exposing the internal jugular vein low in the neck, and puncturing it at a place where the flux and reflux of the blood are plainly discernible, there is perceived in the first inspiratory effort made by the animal after the wound, a peculiar lapping, or gurgling liquid, hissing sound; the nature of the sound depending partly on the size and the situation of the opening in the vessel. At the same time a few bubbles of air are seen to be mixed with blood at the orifice in the vein. The entrance of the air is immediately followed by a struggle during the deeper

inspirations, in which fresh quantities of air gain admittance, the entrance of each portion being attended by the peculiar sound, above described. On listening now to the action of the heart, a loud churning noise will be heard, synchronous with the ventricular systole, and the hand will, if applied to the parietes of the chest, perceive at the same time a peculiar bubbling, thrilling, or rasping sensation, occasioned by the air and blood being, as it were, whipped together between the columnæ carneæ and cordæ tendineæ. As the introduction of air continues, the circulation becomes gradually more feeble and languid; the heart's action, however, being fully as forcible, if not more so, than natural. The animal soon becomes unable to stand: if placed upon its feet, rolls over on one side, utters a few plaintive cries, is convulsed, extrudes the fæces and urine, and dies. If the thorax be immediately opened, it will be seen that the heart's action is continuing regularly and forcibly, and that the pulmonic cavities, though filled, do not appear distended beyond their ordinary size.

Death occurs, as I have shown, in a paper on this subject, published in the 158th number of the "Edinburgh Medical and Surgical Journal," in consequence of the air and blood being beaten up together in the right cavities of the heart into a spumous froth, which cannot be propelled through the pulmonary vessels; hence there is a deficient supply of blood to the brain and nervous centres, and fatal syncope comes on, attended usually by convulsions.

The spontaneous entry of air into the veins of *man* is attended by two distinct sets of phenomena, one of a local, the other of a constitutional character.

The local phenomena consist in a peculiar sound, produced by the entrance of the air, and in the appearance of bubbles about the wound in the vein. The sound is of a hissing, sucking, gurgling, or lapping character, and never fails to indicate the dangerous accident that has occurred. When once heard, whether in man or the lower animals, it can never be mistaken. It has fortunately only fallen to my lot to hear this sound in the human subject on one occasion; that of a patient who had attempted suicide by cutting his throat. The internal jugular being wounded, was being raised for the purpose of having a ligature passed under it; at this moment a loud hissing and gurgling sound was heard, some bubbles of air appeared about the wound, the patient became faint, and greatly oppressed in his breathing. The ligature was immediately tightened, the faintness gradually passed off, and no bad consequences ensued.

The *effects* produced upon the constitution are usually very marked. At the moment of the entry of the air, the patient is seized with extreme faintness, and a sudden oppression about the chest; he usually screams out, or exclaims that he is dead or dying, and continues moaning or whining; the pulse becomes nearly imperceptible, and the heart's action laboring, rapid, and feeble; death commonly results, but not instantaneously, in many cases at least. Thus Beauchesne's patient lived a quarter of an hour after the occurrence of the accident; Mirault's between three and four hours; and Clemot's several hours. Amongst the other recorded fatal cases I have not been able to find any but vague statements as to the length of time the patients survived.

If the patient survive the immediate effects of the accident, he may probably recover without any bad symptoms, as happened in the case to which I have referred, as occurring at the University College Hospital, and in an instance recorded by B. Cooper. The presence of the air in the pulmonic capillaries would appear in some cases to act as an irritant, and induce fatal pneumonia or bronchitis, as happened to the patients of Roux and Malgaigne.

The *cause* of the spontaneous entry of air into the veins has been very completely investigated and determined by the French Commission. If we open a large vein at the root of a dog's neck, near the thorax, in which the venous pulse, or flux and reflux of the blood is perceptible, we shall see that air rushes in at each inspiration—but only at this time—never gaining entry during expiration. This is owing to the tendency to the formation of a vacuum within the

thorax, more particularly in the pericardium, during inspiration. This suction action, or "venous inspiration," is confined to the large vessels in and near the thoracic cavity, being limited, by the collapse of the coats of the veins, at a little distance from this. If the veins were rigid tubes, it would extend throughout the body, but as they are not, it ceases where their coats collapse. It is indeed limited to that part of the root of the neck and the axilla, where the venous flux and reflux are perceptible, and the space in which it occurs has been termed the "dangerous region." But under certain circumstances air may spontaneously gain admission beyond this.

It is well known that what is called by the French writers the "canalisation" of a vein, or its conversion into a rigid uncollapsing tube, is the condition of all others which is most favorable to the introduction of the air into it. Indeed, except in those situations in which there is a natural movement of flux and reflux of the blood in the veins, this accident cannot occur unless these vessels be canalised, or, in other words, prevented from collapsing. This canalisation of the vessel may be occasioned in a variety of ways. Either the cut vein may be surrounded by indurated cellular tissue, which will not allow it to retract upon itself, but keeps it open, like the hepatic veins; or the coats of the vessel may have acquired, as a consequence of inflammation or hypertrophy, such a degree of thickness as to prevent their falling together when divided. Then again, the principal veins at the root of the neck have, as Bérard has pointed out, such intimate connections with the neighboring aponeurotic structures, that they are constantly kept in a state of tension, so that their sides are held apart when they are cut across. The contractions of the platysma and other muscles of the neck may likewise, as Sir C. Bell has shown, have a similar effect. In removing a tumor also, that is situated about the neck, the traction exercised upon its pedicle may, if this contain a vein, cause it to become temporarily canalised; and the incomplete section of the vessel, especially in a transverse direction, must prevent the approximation of the sides of the incision in it, which will be rendered open and gaping by the retraction of the surrounding tissues. This patency in the incision in the vein, is apt to be increased by the position that is necessarily given to the head and arm in all operations of any magnitude about the shoulders and neck. Lastly, the introduction of air into a vein will be favored by the vessel being divided in the angle of a wound, the vein being, when the flaps that form that angle are lifted up, rendered open-mouthed and gaping.

On looking over the reports of cases in which air gained admittance into the veins during operations, it will be found that these vessels were always in one or other of the above-mentioned conditions. Thus, in Beauchesne's case, air was introduced in consequence of incomplete division of the external jugular, immediately above the right subclavian, whilst in a state of tension, during the removal of a portion of the clavicle. In a case that occurred to Dupuytren, a large vein connected with the tumor, and communicating with the jugular, was cut at the last stroke of the scalpel, whilst the tumor was being forcibly drawn up. The vein was found to be adherent to the sides of a sulcus, so that it remained gaping when cut. In a case by Delpech, there was hypertrophy of the axillary vein, causing it to gape like an artery. In Castara's case there was incomplete section of a vein, which opened into the subscapular, whilst the tumor was being raised up. In Roux's case, a vein in the neck was opened, whilst a tumor, which was being removed from that region, was being forcibly raised, in order to dissect under it. Ulrick saw the accident occur in consequence of the incomplete division of the internal jugular vein, which was implicated in a tumor in the neck. A similar case happened to Mirault of Angers, the internal jugular being divided to half its extent. A case occurred to Warren, in which the air entered by the subscapular vein, the coats of which were healthy, but in a state of tension, in consequence of the position of the

arm; and another, in which the same accident happened from the division of a small transverse branch of communication between the external and internal jugular, whilst in a state of tension. Mott, whilst removing a tumor of the parotid gland, opened the facial vein, which was in a state of tension in consequence of the position of the patient's head, when air was introduced. A case is related by Malgaigne in which the accident happened in consequence of the incomplete section of the external jugular vein, which was enveloped in a tumor that was being removed. M. Bégin also relates a case in which the accident happened, in consequence of the puncture of the internal jugular whilst he was removing a tumor from the neck.

These cases, which are all that I have been able to meet with, in which the condition of the wounded vein was particularized, show clearly what is the state of the vessel and of the surrounding parts that is most likely to favor the occurrence of the accident, and consequently what the surgeon should peculiarly guard against in the removal of tumors about the neck and shoulders; viz., incomplete division of the veins, and the employment of forcible traction on the diseased mass at the moment of using the scalpel. In removing tumors from the neck and shoulder, it is in many cases impossible to avoid drawing them forcibly upwards or forwards, in order to get at their deeper attachments; but if this be necessary the chest should, for reasons that will immediately be pointed out, be tightly compressed, so that no deep inspirations may be made at the moment that the knife is being used, or before a divided or wounded vein can be effectually secured.

Preventive Treatment.—When a patient is under the knife, the respirations are generally shallow and restrained, the breath being held, whilst every now and then there is a deep gasping inspiration, at which moment, if a vein be opened in which the pulse is perceptible, or that is canalised, air must necessarily be sucked in; and, as has already been said, in quantity and force proportioned to the depth of the inspiration. This, then, being the case, the mode of guarding against the introduction of air into the veins is obvious. The chest and abdomen should be so tightly bandaged with broad flannel rollers or laced napkins, as to prevent the deep gasping inspirations, and to keep the breathing as shallow as possible, consistently with the comfort of the patient. I have often found, that the entrance of air into the veins of a dog could be arrested by forcibly compressing the chest of the animal, so as to confine the respiratory movements, but that as soon as a deep inspiratory effort was made, the compression having been removed, a rush of air took place into the vessel. If, therefore, during an operation about the root of the neck or summit of the thorax, the chest be bandaged, as here recommended, the surgeon must be careful not to remove the compression until the operation is completed, and the wound dressed; for if this precaution be not attended to, the patient will, most probably, on the bandage being loosened, make a deep inspiration, and air may be sucked in at the very moment that all appeared safe.

Curative Treatment.—Different plans have been recommended by surgeons for the treatment of those cases in which air has already gained admittance into a vein; but, from the very fatal nature of this accident, it does not appear that much benefit has resulted from any of them: the recovery of the patient, in some of the cases, appearing to be rather due to the quantity of air that was introduced being insufficient to cause death, than to any effort on the part of the surgeon. The two principal modes of treatment that have been recommended, consist in the suction of the air from the right auricle, and the employment of compression of the chest. Thus, Amussat and Blandin advise us to introduce the pipe of a syringe, a female catheter, or a flexible tube, into the wounded vein, if it be large enough to admit the instrument, and if not, to open the right jugular, and pass it down into the auricle, and then to employ suction, so as to empty the heart of the mixture of blood and air At the same

time that this is being done we are, say they, to compress the chest as forcibly as possible, so as to squeeze more of the air out of the heart. Magendie and Rochoux advise suction alone; and Gerdy recommends us to be content with compression of the chest. Warren (of Boston) directs us according to the condition of the patient, to have recourse to bleeding in the temporal artery, to tracheotomy, or stimulants.

The indications that present themselves in the treatment appear to me to be threefold:

1st. To keep a due supply of blood to the brain.

2d. To maintain the powers of the heart until the obstruction in the pulmonic capillaries can be overcome or removed.

3d. To remove, if possible, the obstruction in the capillaries of the lungs.

We shall now see how far the means already mentioned, viz., suction, compression, &c., can fulfil these indications. And, first, with regard to suction, it would no doubt be highly advantageous if we could, by this or any other means, remove the air that has gained access to the heart, and thus prevent the pulmonic capillaries from being still farther obstructed. But, putting out of consideration the difficulty of finding the wounded vein, the still greater difficulty of introducing a suitable tube a sufficient distance into it — the danger of allowing the ingress of a fresh quantity of air whilst opening the sides of the incision in the vein, so as to introduce the tube, and the risk there would be, if the patient recovered from the effects of the accident, of having phlebitis induced;—putting all these circumstances aside, which appear to me to be most serious objections, it becomes a question, according to Amussat, who is one of the strongest advocates of this mode of practice, whether by suction with a syringe, or even by the mouth, any material quantity of air can be removed. He says that even when the tube is introduced into the right auricle, much more blood than air is constantly withdrawn. These considerations, then, should, I think, make the surgeon hesitate before having recourse to such a hazardous mode of procedure.

The next plan, that of circular compression of the chest, however valuable it may be in preventing the ingress of air, can, when that fluid has once been introduced into the veins, have no effect in removing it from the circulatory system. We cannot by any compression that we may employ, squeeze the air out of the heart. But compression may not only be productive of no positive good, but may even occasion much mischief, by embarrassing still farther the already weakened respiratory movements, and thus interfering with the due aeration of the small quantity of blood that may yet be traversing the lungs.

Bleeding from the temporal artery can by no possibility be productive of any but an injurious effect, by diminishing the already too small quantity of blood in the arterial system. Opening the right jugular vein may, perhaps, to a certain extent, be serviceable, by unloading the right cavities of the heart, as Dr. Reid has shown it to be capable of doing, and it has been recommended by Dr. Cormack on this account. Lastly, tracheotomy cannot be of any particular service, as the arrest of the respiratory function is secondary and not primary.

What, then, are the measures that a surgeon should adopt in order to prevent the occurrence of a fatal termination in those cases in which air has accidentally been introduced into the veins during an operation? Beyond a doubt, the first thing to be done is to prevent the further ingress of air, by compressing the wounded vein with the finger, and, if practicable, securing it by a ligature. At all events, compression with the finger should never be omitted, as it has been shown by Nysten, Amussat, Magendie, and others, that it is only when the air that is introduced exceeds a certain quantity, that death ensues. All further entry of air having thus been prevented, our next object should be to keep up a due supply of blood to the brain and nervous centres, and thus maintain the integrity of their actions. The most efficient means of accomplishing this

would probably be the plan recommended by Mercier, who believing that death ensues in these cases, as in prolonged syncope, from a deficient supply of blood to the brain, recommends us to employ compression of the aorta and axillary arteries, so as to divert the whole of the blood that may be circulating in the arterial system to the encephalon. This appears to me to be a very valuable piece of advice, and to be the most effectual way of carrying out the first indication, that of keeping up a due supply of blood to the brain and nervous centres. The patient should, at the same time that the compression is being exercised on his axillary arteries and aorta, or, if it be preferred, as more convenient and easier than the last, on his femorals, be placed in a recumbent position as in ordinary fainting, so as to facilitate the afflux of blood to the head. The compression of the axillary and femoral arteries may readily be made by the fingers of two of those assistants that are present at every operation.

For the fulfilment of the second indication, that of maintaining the action of the heart until the obstruction in the capillaries of the lungs can be overcome or removed, artificial respiration should be resorted to, as the most effectual means of keeping up the action of that organ.

For the purpose of keeping up artificial respiration, the Humane Society's bellows, if they be at hand, might be used, or, if they cannot readily be procured, the surgeon must inflate with his mouth. Before inflating the lungs it will be necessary to remove everything that can compress the chest, or interfere in any way with the free exercise of the respiratory movements. Friction with the hand over the præcordial region, and the stimulus of ammonia to the nostrils, may at the same time be resorted to.

The third indication — that of overcoming the obstruction in the pulmonic capillaries — would probably be the best fulfilled by the means adopted for the accomplishment of the second, viz., artificial inflation of the lungs. That the action of respiration, if kept up sufficiently long, will enable the capillaries of the lungs to get rid of the air contained in them, appears to be the case; for I have several times observed that, if a certain quantity of air be spontaneously introduced into the jugular vein of a dog, and artificial respiration be then established, and be maintained for half or three-quarters of an hour, but a very small quantity indeed, if any, will be found, on killing the animal, in the cavities of the heart or in the branches of the pulmonary vessels. I am aware that this is not altogether conclusive of the fact, as the air might be dissolved in the blood, or might still exist in the capillaries of the lungs, although none might be found in the larger branches of the pulmonary artery; but still it seems to me that we can hardly account for the large quantity of air that will disappear when artificial respiration is kept up, in any other way than that some, if not all of it, passes out of the capillary vessels into the air-cells of the lungs.

CHAPTER XI.

INJURIES OF ARTERIES.

An artery may be bruised, torn, punctured, or cut. A slight bruise of an artery is not attended by any bad consequences, but if the contusion be severe, obliteration of the vessel may ensue from adhesive inflammation some days after the accident. Thus, a patient was admitted into University College Hospital,

under Mr. Quain, with a contused wound in the axilla, received by falling upon some iron railings; no change took place in the circulation of the arm for two days, when pulsation in the radial artery ceased, the injured vessel having evidently become obliterated by adhesive inflammation.

An artery may be torn either partially or completely across. When partial rupture occurs, the internal and middle coats only give way, the toughness of the external coat preventing its laceration. This accident is especially apt to occur as a consequence of blows or strains upon diseased or weakened vessels, and thus may possibly lay the foundation for aneurism. In other cases the ruptured portion of the coats becomes turned down into the inside of the vessel, and, acting as a valve, prevents the further progress of the blood through it, thus giving rise to gangrene of the limb. In some cases the partially ruptured vessel becomes blocked up by plastic matter, occluding its interior, but without gangrene resulting.

The complete rupture of an artery may occur either in an open wound or under the integuments. When an artery is torn across in an open wound, as by the avulsion of a limb by machinery, or by a cannon-shot carrying it off, there is usually but little hemorrhage, even from the arteries of the magnitude of the axillary or femoral, and though the vessel hang out of the wound, pulsating to its very end. This absence of bleeding is owing to the internal and middle coats, which are fragile, breaking off short and contracting somewhat; whilst the external coat and the sheath of the vessel, being elastic, are dragged down and twisted over the torn end of the artery, so as completely to prevent the escape of blood.

When the laceration of the artery is subcutaneous, as occasionally happens in the attempted reduction of an old dislocation of the shoulder, either extensive extravasation, or one or other of the varieties of traumatic aneurism, may be produced.

Wounds of arteries may be divided into those that do not penetrate into the interior of the vessel, and those by which it is laid completely open.

Non-penetrating wounds of arteries are very rare. Mr. Guthrie, however, relates the case of a gentleman who cut his throat, and in whom the carotid artery was exposed and notched through the external and middle coats only; the vessel finally gave way on the eighth day, fatal hemorrhage ensuing. A case also lately occurred at the London Hospital, in which a suicidal wound of the throat had exposed the carotid artery. After death it was found that the inner and middle coats of the vessel had been divided by the pressure of the knife, which was blunt, but the external coat had been left entire, and under this a dissecting aneurism was found.

In *penetrating wounds* of an artery, we have always hemorrhage of an arterial character, unless the puncture be made with so fine an instrument as to be closed by the mere elasticity of the coats of the vessel. Thus, Maisonneuve has shown that an artery may be punctured with a fine needle without any hemorrhage or other unfavorable result occurring. If, however, the puncture be larger than this, being made by a tenaculum or hook, it does not commonly close in this way; and if hemorrhage do not take place immediately, it will probably come on in the course of a few hours or days, from ulceration of the vessel. If the wound be larger than this, there is always an amount of hemorrhage proportionate to its size, and to that of the vessel.

The *direction* of the wound in the artery influences materially its characters. If the cut be parallel to the axis of the vessel, there is less tendency to gaping of the edges than if it be oblique. In transverse wounds of arteries, the retraction of the coats is so great as to cause the wound to assume somewhat of a circular appearance. If the artery be cut completely across, there is always a less degree of hemorrhage than when it is partially divided, for the retraction and contraction of the cut ends may then be sufficient to close the vessel, which

is not the case when it is merely wounded. When the wound in the artery is subcutaneous, communicating only by an oblique and narrow aperture with the surface, but little, if any, external hemorrhage takes place, but extravasation of blood occurs. The extravasation may either be poured into one of the serous cavities, or it may be diffused in the cellular tissue of the limb or part, infiltrating it deeply and extensively; and perhaps by its pressure giving rise ultimately to gangrene; or it may be effused in a more circumscribed manner, giving rise to one or other of the forms of traumatic aneurism.

ARREST OF HEMORRHAGE.[1]

The *arrest of arterial hemorrhage* is perhaps the most important topic that can engage the surgeon's attention, as on the safe accomplishment of this the success of every operation is necessarily dependent. In studying this subject, we must first investigate the means that are adopted by nature for the supression of the hemorrhage; and, secondly, how these may be imitated by art.

The *natural arrest* of arterial hemorrhage is effected by means that are in the first instance of a temporary, but afterwards of a permanent character. The means which secure *temporarily* the flow of blood from an artery, and which, if the vessel be of a small size, as the facial or radial, are sufficient in many cases to stay the hemorrhage without the interference of the surgeon; and by which, whatever be its size, his operations are materially assisted, and nature makes an effort, though it may be an unsuccessful one, to prevent a fatal escape of blood, are threefold. They consist —

1st. In an alteration in the constitution of the blood.

2d. In a diminution of the force of the heart's action, and consequently of the pressure on the inner coat of the vessel.

And 3d. In certain changes effected in and around the artery.

1st. The *alteration that takes place in the blood* consists in an increase of its plasticity as it flows. The blood that escapes from a wounded artery has from the first a tendency to glaze and coagulate about the cut vessel, so as to offer a mechanical obstacle to the further escape of blood from it. This of itself is sufficient in the smaller vessels to arrest the hemorrhage, the more so, as has

[1] The history of the investigations into the means adopted by nature for the arrest of hemorrhage, is full of interest to the surgeon, and is excellently given in Jones's work on hemorrhage. No subject in surgery affords a stronger evidence of the advantage of the application of "Experimental Pathology" to practice, than this, as our knowledge of it has been wholly gained by experiments on the lower animals.

Petit, who published several memoirs on this subject in 1731 and following years, states that hemorrhage is arrested by the formation of two clots—one outside the vessel, which he calls the "Couvercle;" the other inside, the "Bouchon"— the first being formed by the last drops of blood that issue, the second by the few drops that are retained. These clots by their adhesion stop the bleeding. When a ligature is applied, a similar clot forms above and below it. He recommends compression, and the support of the clot.

Morand, in 1736, added much of interest. He admitted the formation of coagula, but insisted on the change in the artery itself; which he showed became corrugated, contracted, and retracted. Morand entertained erroneous views as to the structure and functions of arteries, but he established the great fact that changes occur in the artery itself.

Kirkland, in 1763, wrote an excellent treatise on the subject, and his views were adopted and supported by White, Gooch, Aiken, and other surgeons of his day. He showed that hemorrhage was lessened by swooning; and, that an artery contracted up its nearest collateral branch, and was of opinion that coagulum did not arrest the bleeding.

J. Bell took a retrograde step on this subject, by denying the retraction and contraction of the artery, and the importance of the internal coagulum, and by attributing the arrest of hemorrhage solely to the injection of the surrounding cellular tissues with blood.

It was not until 1805 that Mr. Jones, by a series of admirably conducted investigations, finally determined the mode in which the arrest of hemorrhage takes place. Since his time but little has been added to the subject, so complete has been his examination of it.

been pointed out by Hewson, in consequence of the last flowing blood being more coagulable than the first.

2d. The *diminution in the force in the heart's action* exercises a very material influence in arresting the flow of blood from an artery. The forcible manner in which the jet of blood is propelled at each systole of the ventricle, is the principal obstacle to the coagulation of the blood around and within the cut vessel; for not only does the movement of the blood prevent coagulation, but so long as the jet is more powerful than the cohesion of the clot, it will certainly wash the coagulum away. As the blood flows and the heart's impulse becomes gradually lessened in force, the jet becomes lower and lower, until at last, when faintness comes on, it is almost entirely arrested, and time is afforded for the formation and the deposit of a coagulum in the vicinity of the wound.

3d. The *changes that take place in and around the vessel itself* are those upon which the final arrest of the bleeding is dependent. They consist in the *retraction* of the artery within its sheath, in the *contraction* of the cut ends, and in the *formation of a coagulum* around its exterior, and in its interior.

When an artery is cut across, it immediately retracts within its sheath, the interior of which is left rough and uneven. Through this uneven channel the blood is projected, either flowing freely externally or being extravasated into the neighboring cellular tissue, according to the direction and state of the wound. As the blood flows over the roughened surface of the sheath, it becomes entangled in the fibres, and tends to coagulate upon them; this tendency to coagulation is favored by the increased plasticity of the blood as it flows, and by the diminution of the propulsive force with which it is carried on. By the conjoined operation of these causes a coagulum is formed, which, though lying within the sheath, is outside to, and extends beyond the artery; and is hence termed the *external coagulum*. It is usually of a somewhat cylindrical shape, and often looks like a continuation of the vessel, being at first perforated by a hollow track, through which the stream of blood continues to flow. As it increases, the hollow becomes closed by the concentric deposit of coagulum. The hollow track leading from the surface of the coagulum to the wound in the artery, has been especially described and dwelt upon by Amussat. This coagulum acts mechanically by blocking up the end of the artery, and also by compressing the vessel within the sheath; thus constituting the first barrier to the hemorrhage. The formation of the external coagulum is thus in a great measure dependent on the retraction of the artery within its sheath.

The next changes that take place in the artery, and, indeed, that are to a certain extent simultaneous with those that have just been described, are, its *contraction* and the formation of the *internal coagulum*.

The *contraction* of the cut artery commences immediately after its division, and may of itself be sufficient to close the smaller arteries. Thus, during an operation, we may often see an artery which, when first cut, jetted a stream of blood as large as a straw, gradually contract in size until it cease to bleed, owing simply to this contraction. In the larger arteries this process is not sufficient to close completely the vessel, but merely gives its cut end a conical shape, diminishing greatly the aperture and converting it into a kind of pinhole at the end of the artery.

In proportion as the open end of the artery is obstructed by the external coagulum and contracts in diameter, the blood is propelled with more and more difficulty through it, until at last it escapes in but a small and feeble stream, or even becomes completely at rest, allowing its fibrine to be deposited in a slender coagulum, which plays a more important part in the permanent than in the temporary arrest of the bleeding. To the formation of this *internal coagulum* the contraction of the vessel is subservient. This coagulum is slender

and of a conical shape, the base being attached to the margins of the aperture in the vessel, and the apex extending upwards. It has no point of attachment except by its base, the apex and sides being perfectly free; it is at first composed entirely of coagulum, though of a firm fibrinous character, no exudative matter entering into its composition at this period, though after-changes of an important character occur within it. The importance of the internal coagulum, as a temporary means of arresting hemorrhage, though great, has, I think, been over-estimated. In many cases it is not formed at all; this happens in certain states of the blood when that fluid is devoid of plasticity, and in some cases the proximity of a collateral branch to the cut end of the vessel appears, by preventing the stasis of the blood within it, to interfere with its coagulation; even when it is formed, it is but of little service, so far as the primary arrest of the hemorrhage is concerned, not being deposited until after the flow of blood has been checked by other means, such as the deposit of the external coagulum and the contraction of the vessel. After it is formed, it is useful in acting as a damper, and in breaking the force of the wave of blood against the cut end of the vessel. It is in the permanent arrest of hemorrhage that the internal coagulum is of great importance. After the hemorrhage from the cut artery has been arrested temporarily by the means that have been indicated, nature proceeds to secure the vessel by permanently occluding it.

The *permanent* closure of a cut artery is effected by two processes:

1st. By the adhesive inflammation set up in the vessel and the surrounding parts.

2d. By the continued contraction of the artery.

A few hours after the division of the artery, lymph is found to have been poured out both within and on the outside of the injured vessel. The lymph that is thrown out within the vessel forms the most important part of the internal coagulum, and tends materially to the permanent closure of the wound. It is effused from the cut surface of the internal and middle coats around and immediately within the contracted orifice of the vessel, forming a small nodule projecting into its interior. If an internal clot have already formed, this plastic nodule is deposited underneath it, or is effused into its base; if no temporary clot have formed, a conical mass of coagulum will be deposited upon this nodule, in obedience to that law of pathology by which blood tends to coagulate upon inflamed points. When fully formed this coagulum differs materially in structure at different points. At its base it is firm, of a brownish or buff color, and is composed principally of fibrine; above this it becomes dark, morone colored, and ends in a long tail-like projection of simple clot, which extends up to the nearest large collateral branch. The important part of this coagulum, pathologically speaking, is its plastic base; the rest, however long it may be, is of no use in the permanent closure of the vessel; but, like the internal clot already described, merely serves to break the shock of the blood.

Coincident with these changes in the interior of the vessel, important phenomena occur on its exterior. Inflammation takes place in the sheath and in the surrounding parts, a round or ovoid mass of fibrine being here effused, which is at first mixed up with the external coagulum; the coloring matter of this, however, gradually becomes absorbed, leaving the plastic matter accumulated in a mass, and completely blocking up the end of the vessel from the outside.

Under the influence of the inflammation set up within and around it, the artery goes on contracting, until it embraces the included coagulum so firmly that it would appear as if it were adherent to every part of it, and some difficulty is experienced in separating them. That they are not adherent, I have ascertained by finding, on careful dissection, that the transverse striæ of the lining membrane of the artery are always visible, although the coats of the vessel are often stained nearly black by the imbibition of the coloring matter of the blood. The contracted vessel usually assumes a conical shape, but in

some cases I have seen the contraction commence suddenly, and the narrowed part to be perfectly cylindrical for the distance of about an inch.

The changes that have just been described are those that take place in the proximal end of the artery. In the distal or inferior end, occlusion is effected by the same processes essentially, but the retraction and contraction of the vessel are not so complete and extensive, and the coagulum is usually smaller both inside and out; in some cases, indeed, the internal coagulum is deficient. The less perfect closure of the distal end may, as Mr. Guthrie suggests, be the cause of the more frequent occurrence of hemorrhage from it.

The ultimate change that takes place in the divided artery, is, the transformation of its cut extremity up to the first collateral branch, into a dense fibro-cellular cord. This is effected by the plastic effusion inside and outside the artery, with the cut and contracted vessel in the centre, developing into fibro-cellular tissue.

The arrest of hemorrhage from a *punctured* or *partially divided* artery is effected in a somewhat different manner to what has been just now described; the difference consisting in the changes that go on in the neighborhood of the wound. If the wound in the soft parts covering the artery be of small size, and oblique in direction, so that the blood does not escape with too great facility, it will be found that the temporary arrest of the hemorrhage takes place by an extravasation of blood occurring between the artery and its sheath, by which the vessel is not only compressed, but the relations between the wound and the aperture in the sheath are altered. This stratum of coagulated blood extends for some distance within the sheath, above and below the wound, opposite to which it is thicker than elsewhere. Coagulum may likewise be formed in the tissues of the part outside the sheath, by which the vessel is still further compressed, and the tendency to the escape of blood proportionately lessened.

The permanent closure of the puncture is effected by the adhesive inflammation. Lymph may be effused in such a way as to be sufficient merely to plug the wound in the coats, or else it may be in sufficient quantity to obliterate the whole of the interior of the artery, producing complete occlusion of it. In order that the wound in the artery should unite without obliterating the cavity of the vessel, but simply by the formation of a cicatrix in the coats, it is necessary that it be below a certain size; but this size will vary according to its direction. If the wound be longitudinal or slightly oblique, it will be more likely to unite in this way than if transverse. Mr. Guthrie states that in an artery of the size of the temporal, a small longitudinal wound may sometimes heal without obliteration of the vessel, though this very rarely happens in arteries of larger size. If a vessel the size of the femoral be opened to the extent of one-fourth of its circumference, there is no proof that the wound can heal without obliteration of the cavity of the artery; but when the longitudinal wound is very small in a large artery, little more than a puncture, closure may possibly take place simply by its cicatrization. The plastic matter forming the cicatrix is thrown out by the external coat of the artery. The internal and middle do not unite strongly, the aperture in them being merely filled up by a plug of lymph; hence the artery always continues weak at this point, and may eventually become aneurismal.

If an artery of the second or third magnitude, as the axillary or femoral, be divided to one-fourth or more of its circumference, either fatal hemorrhage or the formation of a traumatic aneurism will usually take place. In those comparatively rare cases, however, in which the hemorrhage is arrested without these consequences ensuing, it will be found that it is so, by the vessel becoming obliterated by a plug of lymph, which is poured out at the wounded part, and gradually encroaches on the cavity of the artery, until complete obliteration is produced, and the vessel at the seat of obstruction becomes converted into a fibro-cellular cord.

THE SURGICAL TREATMENT OF HEMORRHAGE FROM WOUNDED ARTERIES.

The object of the surgeon, in any means that he adopts for the suppression of arterial hemorrhage, is to imitate, hasten, or assist the natural processes, or to excite analogous ones. All his means act by increasing the retraction and contraction of the arterial coats in forming an artificial coagulum, or in exciting adhesive inflammation in and around the vessel.

The danger from arterial hemorrhage, and the measures that must be adopted to meet it, vary according to the size of the vessel. Under all circumstances the surgeon should bear in mind the excellent advice given by Mr. Guthrie, never to fear bleeding from any artery on which he can lay his finger; the pressure of this readily controlling the bleeding from the largest vessels, provided it can be fairly applied, or the cut end of the artery seized between the finger and thumb. Thus, in amputation at the hip and shoulder joints, the assistant readily controls the rush of blood from the femoral and axillary arteries by grasping them between his fingers; above all, the surgeon should never dread hemorrhage, or lose his presence of mind by its occurrence. If effectual means for its suppression are had recourse to, it can always be, at least, temporarily arrested. And least of all should any surgeon have recourse to inefficient means to stop it, and endeavor, by covering up the wound with rags, handkerchiefs, &c., to prevent the escape of blood. These means only hide the loss that is going on, and by increasing the warmth of the parts, prevent the contraction of the vessels, and favor the continuance of the bleeding. Under all circumstances, therefore, bleeding wounds should be opened up, the coagula gently removed from their surface, by means of a piece of soft sponge or a stream of cold water, and the part well cleaned. In this way "you look your enemy in the face," and can adopt efficient means for the permanent arrest of the hemorrhage.

The flow of blood through a limb may be controlled for a temporary purpose, as during an operation, by the compression of the main artery by the hands of an assistant. This may be done in the lower extremity by pressing the femoral artery against the brim of the pubes, and in the upper extremity by compressing the subclavian against the first rib, or the brachial against the shaft of the humerus. The pressure should be made by grasping the limb with one hand in such a way that the index and middle fingers bear upon the artery, and press it directly against the subjacent bone. If the limb be large, or if long-continued pressure be required, the same fingers of the other hand should be firmly applied upon those that are already compressing the vessel. In some cases, especially when the subclavian or external iliac requires to be compressed, the handle of a large key, or the end of a desk seal covered with leather, will be found the most convenient instrument for applying the pressure.

In most cases, however, in which temporary compression of the artery is required, the *tourniquet* should be employed. It is far safer to trust to this instrument than to the hands of an assistant, however steady and strong When the tourniquet is applied with a sufficient degree of tightness, the whole circulation through the limb may be completely arrested. This can never be done solely by the compression of the main trunk, the collateral and minor supplying-vessels conveying blood into the limb independently of it. Then again if the operation be unexpectedly protracted from any cause, the fingers of an assistant may tire or stiffen, and, by relaxing the steadiness of their pressure, allow hemorrhage to ensue. For these reasons, surgeons almost invariably employ the tourniquet in amputations; and even the late Mr. Liston, who at one period of his career discarded this instrument, commonly employed it during the latter years of his life. There are three tourniquets used by surgeons: — Petit's consists of two plates attached to a band that is buckled round the limb over a pad that has previously been applied above the artery to

be compressed (fig. 18). By the action of a quick screw the plates can be separated, the band tightened, and the pad forced against the artery. In applying the tourniquet, care should be taken not to screw it up until the very moment that the compression is required, and then to do so quickly and with considerable force, lest venous congestion of the limb take place, by the veins being compressed before the circulation in the arteries is arrested. The horse-shoe, and Signorini's and Skey's tourniquets appear to me to have no advantage over the one described, and they possess the disadvantage of not compressing the collateral vessels, and consequently of commanding the circulation in a less perfect manner than the ordinary instrument.

The different means that may be employed for the *permanent* arrest of hemorrhage are the application of cold, styptics, cauterization with the hot iron, and pressure, or the employment of torsion and ligature.

The *application of cold* is sufficient to arrest that general oozing of arterial blood that is always observed on a cut surface. The mere exposure of a wound that has bled freely, so long as it has been covered up by pledgets and bandages, to the cold air, is often sufficient for this purpose. When this does not succeed, the application of a piece of lint, soaked in cold water, will usually arrest the flow of blood. When it is necessary to do this speedily, as in some operations about the air-passages, a small stream of cold water may be allowed to drip into the wound, and thus cause rapid contraction of the vessels, and consequent cessation of bleeding. In cases of bleeding into some of the hollow cavities of the body, as the rectum, vagina, or mouth, the application of ice is advantageous.

Styptics influence powerfully the contraction of the vessels, and by increasing the rapidity of formation, and the firmness of the coagulum, tend to arrest the hemorrhage; they are principally used in bleeding from spongy parts, from cavities or organs, to which other applications cannot readily be made. The great objection to their employment in some wounds consists in their tendency to modify the character of the surface, and to prevent union by the first intention. The most useful styptics are the tincture of the sesquichloride of iron, spirits of turpentine, gallic acid, and matico; the application of alum, or touching a bleeding part with a pointed stick of the nitrate of silver, is also serviceable.

Cauterization by means of the red-hot iron was almost the only mode of arresting arterial hemorrhage that was known to the ancients. It is now comparatively seldom had recourse to, but yet in many cases it is of the most unquestionable utility, and superior to any other means that we possess; more particularly in those cases in which the hemorrhage proceeds from a soft and porous part that will not hold a ligature, or a surface from which many points appear to be bleeding at the same time. A somewhat conical iron should be used of sufficient size, and the hemorrhage will often be staid more effectually if it be applied at a black, than at a red or white heat. As the actual cautery blocks up the artery by a thick slough or eschar, there is always danger of a recurrence of the bleeding when this separates, and the surgeon must be on his guard about the sixth or eighth day lest it break out again.

Direct pressure upon the bleeding part is a very efficient mode of arresting hemorrhage from small arteries. It is not, however, applicable to all parts of the body, as it is necessary that the vessel should have a bone subjacent to it, so as to afford a point of counter-pressure; hence it cannot readily be employed in soft and moveable parts, as the throat or perineum. Pressure may be practised in various ways; sometimes the mere uniform compression of a bandage is sufficient to arrest the hemorrhage; thus oozing from a wound may often be stopped by laying down the flaps, and applying a bandage pretty tightly over them. Sometimes a weight applied upon this will tend still further to arrest the bleeding; as, for instance, by means of a sand-bag laid upon the part. In the case of bleeding from hollow cavities, as the rectum, vagina, or nares, the

hemorrhage may be arrested by the pressure of a plug of sponge or lint, to which sometimes a styptic may advantageously be added. When the hemorrhage proceeds from the puncture of a small or moderate-sized artery, as of the temporal or brachial, pressure should be made against the adjacent bone with a graduated compress and bandage, and be continued for one, two, or three weeks, until complete consolidation of the wound takes place, the vessel becoming obliterated. The *graduated compress* should be at least an inch in thickness, and made of a series of pledgets of lint of a circular shape, gradually diminishing in size. It should be applied with its pointed end resting over the wound in the vessel. In applying it, a piece of adhesive plaster should be laid over the part on which the pressure is to be exercised, and a thick slice of a phial cork, or a fourpenny piece, wrapped in lint, being placed on this, the graduated compress should be bandaged tightly over the whole. When applied in this way, pressure always acts by inducing adhesive inflammation and obliteration of the vessel at the point compressed.

The *torsion of arteries* for the arrest of hemorrhage, mentioned by Galen, and revived by Amussat, Velpeau, and Thierry, has never found much favor amongst surgeons in this country. It may be practised in various ways. Thus Amussat recommends that the artery be drawn out for about half an inch by one pair of forceps; that it then be seized at its attached point with another forceps, and the end be twisted off by about half a dozen turns. Fricke advises that the ends be not taken off, but merely twisted for six or eight times, according to the size of the vessel. Thierry simply seizes the artery and twists it. There can be no doubt that hemorrhage from the largest vessel may be efficiently stopped by its torsion, the artery being placed in the condition of one that is lacerated or torn through. The internal and middle coats are retracted, and the external one twisted into a kind of valve beyond them. A coagulum next forms within the vessel, blocking up its extremity; inflammation then takes place, gluing together the coats of the artery; the twisted end sloughs off, and the vessel becomes occluded up to the nearest collateral branch. The advantage that torsion is supposed to possess over the ligature is, that no foreign body being left in the wound, there is less suppuration, and a greater prospect of union by the first intention. This advantage, however, is more fanciful than real; the twisted end acts as a foreign body, and is as likely to interfere with union as the pressure of a ligature. Torsion possesses the great disadvantages of being less safe, and less readily practised than the ligature, on the larger arteries. Occasionally in operations, however, small arteries, as muscular branches, may advantageously be pinched or twisted once or twice in such a way as to arrest the bleeding from them.

The *ligature* is the means that surgeons commonly have recourse to for the arrest of hemorrhage from wounded arteries.

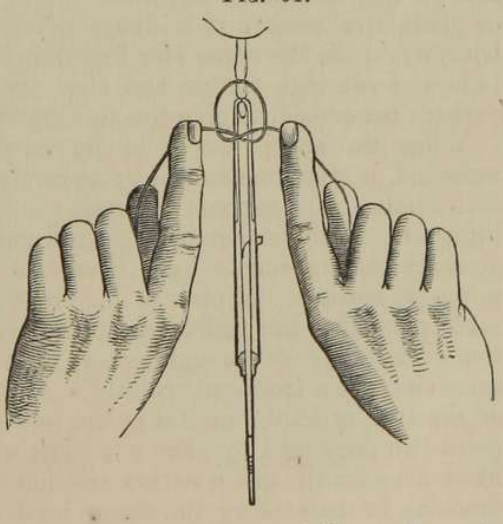
The ligature had been occasionally and partially employed by the later Roman surgeons, but with the decline of surgery fell completely into disuse, giving way to such barbarous and inefficient modes of arresting the hemorrhage as the employment of the actual cautery, the performance of operations with red-hot knives, the application of boiling pitch, or of molten lead, to the bleeding and freshly-cut surface. About the middle of the sixteenth century it was revived or re-invented by that great luminary of the French school of surgery, Ambrose Paré. But so slowly did the ligature make way amongst surgeons, that Sharpe, surgeon to Guy's Hospital, writing in 1761, two centuries after its introduction into practice by Paré, found it necessary, in his well-known work, entitled, "A Critical Enquiry into the Present State of Surgery," formally to advocate its employment for the arrest of hemorrhage from wounded arteries, in preference to styptics or the cautery, on the ground that "it was not as yet universally practised amongst surgeons residing in the more distant counties of our kingdom." What, it may be asked, was the reason that it took two centuries to

promulgate the use of the simplest and most efficacious means we possess in surgery, — a means that no surgeon could now for a day safely dispense with? The reason simply was, that surgeons were totally ignorant of the means employed by nature for the occlusion of arteries, that they consequently knew not how to apply a ligature to these vessels, or what kind of ligature should be used; and that, in their anxiety to avoid the recurrence of secondary hemorrhage, and to make all safe, they fell into the very errors they should have avoided, had they been acquainted with the physiology of the processes that nature employs for the closure of the artery and the separation of the thread.

Between twenty and thirty years after the time at which Sharpe wrote, we find that Hunter introduced that great improvement in the surgical treatment of aneurism,—the deligation of the artery at a distance from the sac, and in a healthy part of its course: but this great accession to the treatment of a most formidable disease was but coldly received, and ran some risk of being lost to the world in consequence of the ill-success that attended the earlier operations. In Mr. Hunter's first operation, four ligatures were used, all of which were applied so slackly as merely to compress the artery for some distance, and to avoid too great a degree of pressure at any one point; the artery was denuded, so that a spatula could be passed under it; and, although in his subsequent operations Mr. Hunter contented himself with employing but one ligature, yet in some of these the vein was included in this; and he did not draw the noose tightly, for fear of injuring the coats of the vessel, in accordance with the doctrine of the day;—surgeons generally at this time being haunted with this dread of injuring, and thereby weakening, the coats of the artery; and in order to avoid doing so, adopted modes of treatment that almost infallibly led to ulceration of the vessels and consecutive hemorrhage. The application of several ligatures of reserve, applied slack—the use of broad tapes—the interposition of plugs of cork, wood, agaric, or lead — of rolls of lint or plaster between the thread and the vessel, were some amongst the plans that were in common use. And how can we be surprised that the patients perished of hemorrhage, and that the ligature of the vessel was nearly as inefficient and fatal a means of arresting bleeding as the use of a cautery, or of a button of white vitriol.

It was not until Mr. Jones, by an appeal to experiment, and by means of a series of admirably conducted investigations, showed that the very point that surgeons were anxious to avoid — the division of the coats of the vessel by the tightening of the noose — was that on which the patient's safety depended; pointed out the form and size of ligature that was most safe, the degree of force with which it should be applied, and the processes adopted by nature for the occlusion of the vessel — that a more rational practice was introduced, and that surgeons at length had full confidence in the use of the ligature.

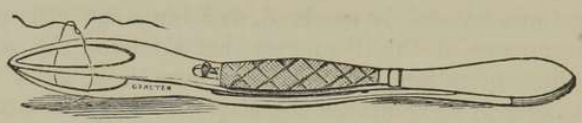
Fig. 61.



The mode of application of the ligature, and the kind of ligature to be used, vary according as the cut end of the artery has to be tied in an open wound, or as the vessel has to be secured in its continuity. When a ligature has to be applied to the divided vessel in an open wound, as after an amputation, the mouth of the artery must be seized and drawn forwards (fig. 61). For this purpose a tenaculum, or sharp hook, is not unfrequently

used, and in many cases answers the purpose exceedingly well. There are, however, some objections to this instrument; thus, it occasionally seizes other tissues with the artery, and as it draws the vessel forwards by perforating its coats, it has happened that an accidental puncture having been made by it behind the part to which the ligature is applied, ulceration of the vessel and subsequent hemorrhage of a fatal character has ensued; as I have seen happen in one case. The most convenient instrument for the purpose of drawing forward the artery, and one to which no objection whatever applies, is Liston's bull-dog forceps. These have been conveniently modified of late by having the blades expanded just above the points (fig. 62), so that the ligature can be slipt over the end of an artery that is deeply seated, as between bones or close

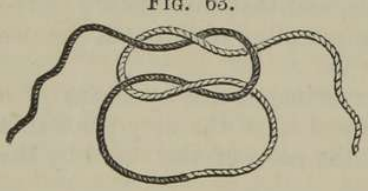
Fig. 62.



to the interosseous membrane of the leg — a situation in which it is sometimes troublesome to tie a vessel by any other means. In some cases the bleeding point may be so situated that the ligature is most conveniently passed under and round it by means of an ordinary curved needle.

The kind of ligature used must vary according to the size of the vessel. If this be small, full round twine; if large, dentist's silk, or compressed smooth whip-cord, should be employed; I always employ the latter in ligaturing the main artery of the limb. Before being used, the ligature should be well waxed, so that it may not be too limp; its strength should be tested by knotting it with a jerk, and if found efficient it may be cut up in pieces eighteen inches in length for use. In applying the ligature, care must be taken that it be put well beyond the cut end of the artery, that it clear the forceps' points, and that it be tied tightly with a reef knot, which does not slip (fig. 63). One end of the ligature should then be cut off about a quarter of an inch from the knot, and the other left hanging out of the wound. The ligature that secures the main artery should have both its ends knotted together by way of distinctive mark. It is always better to leave one end of the ligature; if both be cut off, the noose and knot left are apt to become enveloped by granulations or adhesive matter, and after the healing process is well advanced, or perhaps completed, to give rise to suppuration in and re-opening of the wound.

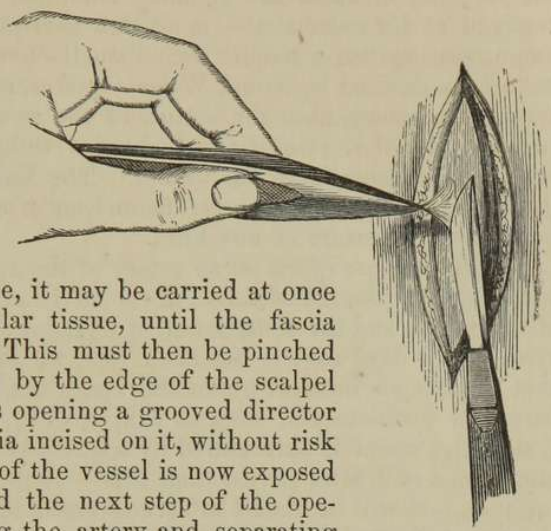
Fig. 63.



When the artery has to be ligatured in its continuity, but at the point wounded, it must be exposed by as careful a dissection as the state of the parts will admit. If a surgeon determine to apply a ligature at a distance from the injury, his anatomical knowledge will guide him to the vessel. This is usually done by cutting through the tissues in the course of the vessel; Hargrave, however, recommends that in ligaturing arteries, the incisions should not be made parallel to the course of the vessel, but in an oblique or transverse direction over it, and this suggestion appears to me to be deserving of attention in some situations, more particularly in the ligature of the brachial at the bend of the arm, or of the carotid at the root of the neck. The surgeon is usually guided to the vessel by some fixed line or point, as the edge of a muscle, which has a determined and constant relation to the artery. Thus in exposing the brachial, he cuts along the inner border of the biceps. In some cases, however, as in the ligature of the iliac arteries, no such certain anatomical guide exists, and then an imaginary line is drawn between two fixed points — as the

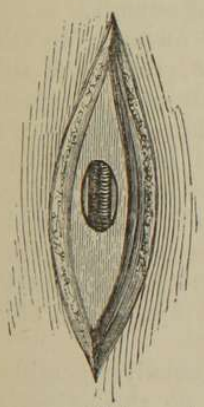
umbilicus and the centre of Poupart's ligament, which becomes the guide to the course of the vessel. These "directing lines" should be carefully studied and kept in mind.

Fig. 64.



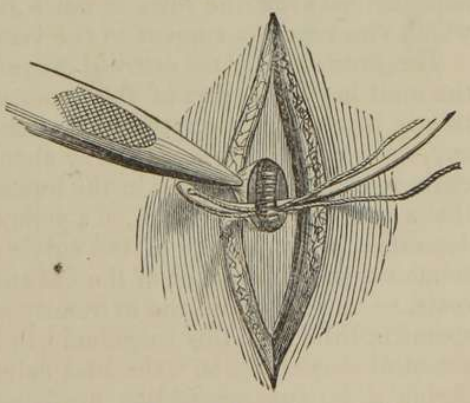
In making the first incision, the skin should be put on the stretch with the fingers of the left hand, or by those of an assistant. If the artery is superficial, or if there are parts of importance in its vicinity, the incision should not penetrate deeper than the skin. But if the vessel be deeply seated and no parts of importance intervene, it may be carried at once through the subcutaneous cellular tissue, until the fascia covering the artery is exposed. This must then be pinched up with the forceps, and opened by the edge of the scalpel laid horizontally. Through this opening a grooved director may then be passed, and the fascia incised on it, without risk to subjacent parts. The sheath of the vessel is now exposed by a little careful dissection; and the next step of the operation, which consists in exposing the artery and separating it from its accompanying vein, is one of great delicacy. This is done by pinching up the sheath with the forceps and applying the knife horizontally (fig. 64). The point should never be used, or the blade turned downwards against the artery, as an incautious movement or the mere pulsation of the vessel might cause it to be wounded. The artery having thus been exposed, the surgeon seizes one edge of the sheath with the forceps, and putting it on the stretch, gently separates the artery from its accompanying vein by teazing through the cellular connections with the end of the aneurism needle, or with a director; being careful not to expose it to a greater extent than is absolutely necessary for the passage of the ligature, lest subsequent sloughing of the vessel ensue, as a consequence of the destruction of the vascular connections between it and the sheath (fig. 65).

Fig. 65.



In opening the sheath, care should be taken not to wound any small branch, lest the collateral supply be interfered with, and danger of secondary hemorrhage induced. The edge of the opening in the sheath being held tightly in the forceps so as to be rendered tense (fig. 66), the ligature should then be carefully passed between the vein and artery, taking care to include only the latter, and especially not to transfix and include a portion of the vein; an accident that often terminates fatally by phlebitis or gangrene. So also the surgeon must be on his guard not to mistake any contiguous nerve for the artery, as has happened to the most experienced operators; and also to avoid transfixing and tying a portion of the thickened sheath instead of the vessel, as I have known happen to a most excellent surgeon. The best material for the ligature when applied

Fig. 66.



to the continuity of an artery, is the dentist's silk or compressed whip-cord, well waxed, and tied in a reef-knot, as represented in fig. 63. Much ingenuity has been expended in devising instruments for passing it under the artery. In the majority of cases the common aneurism needle — well ground down, but rounded at its extremity — is all that is required. Occasionally it may be advantageous to use a needle with a small curve. Many ingenious contrivances have been devised by Trant, Weiss, Coxeter, and others for seizing and drawing forward the noose from the bottom of the wound. After the ligature has been passed under the vessel it should be tied tightly with a reef-knot, and both its ends left hanging out of the wound. The limb should then be elevated and be lightly covered with a piece of flannel, or of cotton wadding; care being taken not to apply pressure of any kind.

The *immediate effects* on an artery of the application of a firm round ligature with a proper degree of force, is the division of the internal and middle coats of the vessel, and the constriction of its outer one. If we examine the ligatured vessel a few days after it has been tied, we find that the coats are contracted, that there is an internal pyramidal coagulum, composed of plastic matter at its base, and fibrinous clot towards it apex (Fig. 67); and that the ligatured portion of the vessel is surrounded by a quantity of lymph. If the artery be examined at a still later period than this — at the end of two or three months, for instance — it will be found to be converted into a fibro-cellular cord as high as the first collateral branch above the ligature (Fig. 69). Now these are analogous appearances to those met with in an artery that has been cut across and occluded without the application of a ligature, and are evidently the result of inflammation of the vessel. The question arises, how this inflammation is set up when a ligature is applied. Is it by the pressure of the noose, or by the division of the coats of the artery? That it is not the mere pressure of the ligature that excites the occluding inflammation, is evident from the experiments of Jones and of Travers, who found that if the ligature be removed shortly after its application, sufficient inflammatory action had been excited in the coats of the artery to lead to its complete occlusion. And though any inflammation set up in the external coat may cause an effusion of lymph inside the vessel, yet that which is required to repair the breach occasioned by the division of the internal and middle coats, is the principal source of the plastic deposit. The changes that take place in the vessel after the application of a ligature require, however, to be more carefully studied.

The *division of the internal and middle coats* should be done evenly, smoothly, and completely, so as to leave a wound that will readily take on the adhesive inflammation. This is best done by a small round ligature, applied with such degree of force that the surgeon feels the coats give way under his finger. The adhesion between the coats is much facilitated by the pressure of the ligature, which also acts as a support to the vessel.

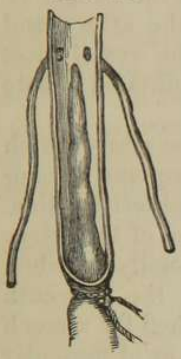
The *formation of the internal coagulum* in the proximal end is the most important part of the process. For the first four-and-twenty hours after the application of the ligature there is little, if any, appearance of this. Usually about this time, if opportunity offers to examine an artery in the human subject, it will be found that a small nodule of lymph, of a yellowish or buff color, has been deposited in the bottom of the cul-de sac that is formed by the retraction and contraction of the cut ends of the inner and middle coats, so as to close up the extremity of the artery. About the second or third day, this coagulum will be found to have assumed a conical shape (Fig. 67), the base being composed of decolorized fibrine and exudation-matter, firmly adherent to the lower end of the artery; the middle and terminal portions of the coagulum, composed of fibrinous clot, and of a dark purple or morone

Fig. 67.

Femoral artery, fifty-six hours after amputation.

color, lie loose and floating in the artery, extending up as high as the first collateral branch. About the tenth day, the inflamed end of the vessel will be found to be tightly and firmly contracted upon the inclosed plug (Fig. 68), the dark-colored portions of which now begin to undergo a process of absorption. Between this period and the sixth week, the contraction of the vessel and the absorption of the free part of the plug go on simultaneously (Fig. 69), the interior of the artery becoming darkly stained by imbibition of the coloring matter of the coagulum. Lastly, the plastic base of the plug becomes incorporated with the contiguous arterial coats, and undergoes eventual transformation into fibro-cellular tissue.

Fig. 68.



Brachial artery, ten days after amputation.

Fig. 69.

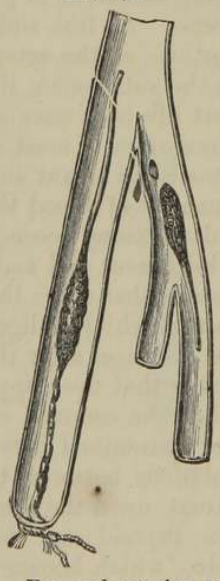
Femoral artery, six weeks after amputation.

In some cases (Fig. 70), there is an imperfect formation of the internal plug, or even total absence of it, and not unfrequently secondary hemorrhage occurs as a consequence. This condition may arise either from want of plasticity in the blood, from an absence of due adhesive inflammation, or from the coats not having been properly cut through. In other cases, in consequence of suppurative action being set up in the artery, a kind of disintegration or liquefaction of the plug takes place after it has been formed. This I have seen happen in a case of ligature of the carotid artery, in which death occurred from visceral disease ten weeks after the operation; and in the femoral, in cases of pyemia (Fig. 71). In the distal cul-de-sac of the ligatured artery I have never seen any very distinct coagulum formed, either in the human subject or in dogs on which I have experimented, but merely small detached fragments of coagula and some plastic effusion.

Fig. 70.

Partial absorption of coagulum in femoral, fourteen days after amputation.

Fig. 71.



Femoral arteries, ten days after amputation of thigh. Death from pyemia.

The changes that take place in the *external coat* are of the most important character. After the internal and middle coats have been cut through by the ligature, the external would not be able to resist the impulse of the blood were it not strengthened and consolidated by the adhesive inflammation. The necessary inflammation is occasioned partly by the dissection required to expose it, and partly by the pressure and irritation of the ligature. Lymph is thrown out between the vessel and its sheath, matting together these parts, and often enveloping the noose and knot in an ovoid mass. Progressively with the effusion of lymph and consequent strengthening of the coats, the pressure of the noose causes gradual sloughing and ulceration of the part included in it. The mode in which the noose ulcerates its way through the external coat is of much importance, as on this depends in a great measure the success of the ligature. There are two sources of danger in connection with this process; either that the sloughing may be too extensive, or that the ulceration through the artery may take place before the adhesive plug is properly and firmly formed.

The chance of the sloughing being too extensive, principally arises from the artery being isolated, and separated from its sheath to too great an extent during the dissection required to expose it, in consequence of which, its nutrient vessels being divided in great numbers, that portion of the coats of the vessel, deprived of its vascular supply, becomes sloughy; hence the danger of passing a spatula, large probe, or the handle of a scalpel under the artery, and also of applying several ligatures. Premature ulceration of the vessel most commonly occurs from the patient's constitution being in too debilitated a state to admit of healthy reparative action.

So soon as the ligature has ulcerated through that portion of the artery which is included in its noose, it becomes loosened and separates; frequently being thrown off with the discharges, or becoming detached on the slightest traction. The period of the separation of the ligature depends upon the size of the artery and the thickness of its coats. From the radial, or ulnar, it is usually detached by the eighth day; from the femoral, iliac, or subclavian, about the sixteenth or twentieth days. In some cases the ligature will continue attached for a much longer period than this, owing to the inclusion of a bit of a nerve or of muscular substance within its noose. In order to hasten the separation in these cases, moderate traction and occasional twisting of the ligature may be practised.

COLLATERAL CIRCULATION.

When the main artery of a limb has been ligatured, or in any other way occluded, it is only the direct flow of blood that is interrupted; the indirect supply which is conveyed into the limb, or part, by the free inosculations between the anastomosing vessels of the different portions of the arterial system, being sufficient to preserve its vitality, and to prevent the occurrence of gangrene. So free and ready are the communications kept up between different portions of the arterial system, that after the largest arteries in the body, such as the subclavian, iliac, and aorta, have been ligatured, sufficient blood to support life is at once conveyed into the parts supplied by them. This *collateral circulation* is most active and most readily maintained in early life, when the vessels are pliant and elastic, readily accommodating themselves to the increased quantity of blood that they are required to convey. As age advances, the vascular system becomes less elastic, and there is a greater difficulty in the establishment and maintenance of the collateral circulation. The anastomosing vessels that serve this purpose are invariably furnished by arteries contiguous to that which is ligatured, and come off from the same side of the body. Thus, for instance, after the ligature of the superficial femoral, it is by the profunda artery that the supply of blood is carried to the lower extremity. Thus also, when the common carotid is ligatured, the circulation to the parts it supplies is not maintained through the medium of the opposite carotid, although the inosculations between the ultimate branches of the two vessels is so free upon the throat, upon the face, and within the cranium; but it is by means of the inferior thyroid and vertebral arteries (branches of the subclavian on the same side), which become greatly enlarged, that the supply of blood is kept up to the parts on the outside, as well as in the inside of the cranium.

The supply of blood that is sent to a limb, after the deligation of the main trunk, is at first but small in quantity; being merely sufficient for the maintenance of its vitality, but not enough for the continuance of the usual actions of the part. Hence, although the life of the limb may be preserved after the ligature of its artery, it becomes cold, and the patient is unable to move it for some time, the muscles appearing to be completely paralyzed; gradually, however, the supply of blood increases, until, having reached its usual standard their normal vigor returns.

By what mechanism is this accomplished? It is due to changes taking place in the capillaries; in the anatomical anastomosing branches, and in the trunk itself.

The capillaries are the first to enlarge; and this they appear to do by a vital process, and not in consequence of the mere increased pressure of the blood, the temperature of the limb often rising, in the course of a day or two, to its normal standard, and sometimes to two or three degrees beyond it; whilst a great sensation of heat is experienced in it by the patient. This period extends over several weeks, and if opportunity be afforded of examining the limb during its continuance, the tissues generally will be found to be preternaturally vascular, admitting injection freely.

Coincident with this increase of activity in the capillary system, the anastomosing vessels of the part enlarge, becoming serpentine, tortuous, and waved, forming circles of an interlaced net-work, During this enlargement much pain is often experienced, owing to their pressure upon neighboring nerves. This form of collateral circulation commences by a general enlargement of all those muscular and subcutaneous secondary vessels of the limb, which can normally be readily distinguished by the naked eye. After this general enlargement has continued for some weeks, it tends to localize itself in a few of the principal anatomical inosculations, until at last it is through their medium that the circulation is chiefly maintained. Thus for instance, after the ligature of the common carotid, the supply of blood is ultimately conveyed by the inosculations between the superior and inferior thyroid arteries, and by the vertebral and basilar. When the subclavian is tied, the circulation of the upper extremity is carried on by the anastomoses between the posterior and supra-scapular, and the branches of the axillary artery distributed to the vicinity of the shoulder; and when the external iliac is tied, the blood is conveyed to the lower limb by the inosculations between the mammary and lumbar arteries, with the epigastric and circumflex ilii.

Jones pointed out the curious circumstance, that when two anastomosing branches approach one another they split, before inosculating, into two or three ramusculi, which by uniting form a circle of anastomoses. Besides this kind of collateral circulation, Maunoir, Porta, and Stilling, have noticed vessels running directly between the extremities of the obliterated trunk, forming species of arterial shoots, springing from the stump of the vessel.

Fig. 72.

The change that takes place in the trunk consists in its conversion into a fibro-cellular cord, from the point to which the ligature has been applied to the first large collateral branch below it (Fig. 72): here it becomes pervious again, and receiving the blood poured into it through the different anastomosing channels, becomes again subservient to the purposes of circulation. Porta and Stilling have shown that, after a time, down the centre of this fibro-cellular cord a small tortuous central canal becomes developed, uniting the two distant ends of the divided artery. This is probably the last change that takes place in the establishment of the collateral circulation.

The collateral circulation is occasionally not sufficiently free to preserve the integrity or vitality of the parts supplied by it. As a consequence of this, gangrene not uncommonly results, or the limb may become paralyzed or atrophied. This condition is most frequently met with in old people, from ossification and rigidity of the arterial system; or it may happen as the result of copious hemorrhage, or of an extensive transverse wound of the limb dividing many of the anastomosing vessels. It more rarely happens that we find too great freedom of the anastomoses, so as to lead to a failure of the

purposes for which the ligature has been applied, by the rapid admission of blood into the distal end of the vessel, and thus perhaps occasioning secondary hemorrhage.

PRINCIPLES OF TREATMENT OF WOUNDED ARTERIES.

The whole of the doctrine of the general treatment of wounded arteries by the ligature may be included in two great principles: 1stly, *To cut directly down on the wounded part, and to tie the vessel there;* and, 2dly, *To apply a ligature to both ends, if it be completely divided, or to the distal as well as the proximal side of the wound, if it be merely punctured.*

These principles of treatment were distinctly laid down by John Bell;[1] but although this great surgeon inculcated forcibly these rules of practice, surgeons appear to have been led away by the erroneous idea of applying the Hunterian principles in the treatment of aneurism to that of wounded arteries, until Mr. Guthrie, by his practice and precepts, and by adducing an overwhelming mass of proof to bear on this important question, has recalled the attention of the profession to the proper and rational treatment of wounded arteries.

1st. The principal reason in favor of cutting down directly upon the wounded part of the injured vessel is, that the ligature of the main trunk only stops the direct supply of blood to the limb, but does not interfere with the anastomosing circulation, which finds its way readily into that portion of the vessel which is below the ligature, and consequently continues to escape by the distal aperture in the artery. Thus, though bright arterial blood may no longer jet from the upper part of the wound, blood which has become of a dark color, in consequence of the changes to which it is subjected in its passage through the vascular net-work of the limb, will continue to well out from the lower aperture in the artery, entailing the necessity of further operative procedure to restrain its flow; and unless this be done, the patient will die of hemorrhage as surely, though perhaps not quite so speedily, as if no ligature had been applied. Thus, if a surgeon endeavors to arrest the flow of blood from a wound of the ulnar artery near the palm by ligaturing the brachial in the middle of the arm, and, when the blood bursts forth as furiously as ever, applies successive ligatures to the arteries of the fore-arm with as little success: he will at last, by the continued recurrence of hemorrhage, be forced to adopt the simple expedient that ought to have been had recourse to in the first instance — of ligaturing the vessel at the point wounded, and thus at length succeed in arresting the bleeding.

Another reason for the practice now advocated is, that in some cases the surgeon cannot possibly know what artery is injured unless he seek for it in the wound itself. A large artery may apparently be wounded, from the direction of the stab and the impetuous flow of blood that has followed it, when in reality it is only a minor branch that has been injured. Thus, for instance, in hemorrhage from a stab in the axilla, which proved fatal, notwithstanding the ligature of the subclavian artery for supposed wound of the axillary, the long thoracic was found to be the vessel divided; so also the external iliac has been ligatured for supposed wound of the common femoral, when in reality it was the superficial external pudic that was injured.

The rule of cutting down on the injured part of the artery applies to all cases in which the wound is still open, whatever be its condition. However deep, inflamed, and sloughy the wound; however ill-conditioned and infiltrated with pus or blood the neighboring parts may be, it may be stated as a general rule (to which, however, there are some exceptions, that will be noticed further on), that there is no safety to the patient unless the vessel be cut down upon and tied at the part injured. This must always be done at any period after the

[1] "Principles of Surgery," vol. i. pp. 350, 390. 8vo. edit.

receipt of the injury, so long as there is an external wound communicating with the artery. An operation of this kind is often attended with the greatest difficulty, not only owing to the hemorrhage that usually accompanies it and obscures the parts, but also in consequence of the altered condition of the tissues in the wound. In order to moderate the hemorrhage, the pressure of an assistant's fingers on the artery high up in the limb must not be trusted to; but a tourniquet should be applied so as completely to arrest the circulation through the limb, and thus to facilitate the search for exposure of the injured vessel, the wound being dry. A large probe should then be passed to the bottom of the wound, and, taking this as the centre, a free incision should be made in such a direction as may best lay open the cavity with the least injury to the muscles and other soft parts. After turning out any coagula contained within it, and clearing it as well as possible, the wounded vessel must be sought for. The situation of this may sometimes be ascertained at once by the gaping of the cut in its coats. In many cases, however, it is necessary to relax the pressure upon the artery, so as to allow a jet of blood to escape, that may indicate the position of the aperture. The ligature may then be applied by passing an aneurism needle under the vessel, if it be partially divided; or, if it be completely cut across, by drawing forwards the end and ligaturing it, as in an open wound. In doing this, care must be taken that the ligature be really applied to the vessel, and that a portion of the sheath infiltrated with blood, or thickened by adherent coagulum, be not mistaken for the artery. The incisions down to the wounded artery should be made on the side of the wound itself, and through the wound in the soft tissues covering it. Guthrie advises, that in those cases in which the wound passes indirectly to the principal artery from the back or outside of the limb, the surgeon need not follow the track of the wound, but may cut down on the vessel where nearest the surface, and then, passing a probe through the wound, the spot at which the artery has probably been wounded will be pointed out, which must then be ligatured in the usual way. No operation should be undertaken unless the hemorrhage be actually continuing. If the bleeding have been arrested, however furious it may have been, the surgeon should never go in search of the wounded vessel, or undertake any operation, unless it burst forth again. A man was brought to the University College Hospital with a deep stab in the groin directly in the course of the external iliac artery; a very large quantity of arterial blood had been lost, but the hemorrhage ceased on his admission, by the application of pressure, etc. From the great and sudden loss of blood, it was supposed that the external iliac had been punctured, but it was not thought advisable to perform any operation unless hemorrhage recurred. The bleeding did not return, the wound healing without any further trouble.

2nd. The second great principle in the treatment of wounded arteries is, that the ligature should be applied to both ends of the vessel, if it be cut completely across, or on both sides of the aperture in it, if it be only partially divided. The reason for this rule of practice is founded on physiological grounds as well as on practical experience. If the anastomoses of the part be very free, as in the arteries of the palm or fore-arm, bleeding may continue from the distal end uninterrupted by the ligature on the proximal side of the wound. If less free, it will probably issue in a stream of dark venous-looking blood in the course of two or three days. After the collateral circulation has been sufficiently established, bright scarlet blood will burst forth from the distal aperture. Experience has shown that it is in this way that secondary hemorrhage from wounded arteries commonly occurs, the bleeding coming from the distal and not from the proximal end of the vessel. In some cases the distal end is so retracted and covered in by surrounding parts, that it cannot be found to be ligatured. Under these circumstances the best practice has resulted by plugging the wound from the bottom with a graduated sponge compress.

Although advocating strongly the importance of the distal as well as the proximal ligature in all cases of wounded artery, I am aware that instances are on record in which the proximal ligature alone, and that even at a distance from the wound, has proved successful in arresting the hemorrhage; but I cannot do otherwise than regard these cases as accidentally successful, the distal end having been better plugged than usual with coagulum; and I am strongly of opinion that the rule of practice should be that which is laid down by John Bell, and so forcibly and copiously illustrated by Mr. Guthrie, viz. :—That both ends of a wounded artery be sought for, and tied in the wound itself.

TRAUMATIC ANEURISMS.

We have hitherto discussed the treatment of an injured artery having an open wound communicating with it. It often happens, however, that the case is not so simple as has been described, but that in addition to the wound in the vessel, we have a subcutaneous extravasation of blood with more or less pulsation, thrill, and bruit, from the projection into it of the blood from the wounded vessel. These *traumatic aneurisms* are of two kinds, the *diffused* and the *circumscribed*.

1st. The *diffused traumatic aneurism* consists of an effusion of blood poured out by, and communicating with the wounded artery; limited in extent by the pressure of surrounding parts, and partially coagulating in the meshes of the broken down cellular tissue. Its boundary, which is ill defined, is composed partly of this coagulum, and partly of plastic matter, effused by the tissues into which it is poured out, and has a constant tendency to extend by the pressure of the fluid blood, which continues to be projected into the centre of the tumor.

This form of traumatic aneurism is indicated by a subcutaneous, soft, and fluctuating tumor, often of considerable size, composed of extravasated blood. At first the skin covering it is of its natural color, but it gradually becomes bluish, and is thinned by the pressure to which it is subjected. If the wound in the vessel be rather large and free, there will be a distinct pulsation in the tumor synchronous with the beat of the heart, accompanied by a thrilling, purring, or jarring sensation, and often a distinct and loud bruit. In other cases, again, if the injured artery be small, or if the wound in it be oblique, and of limited size, there will be no distinct pulsation or bruit; the tumor being either indolent and semi-fluctuating, or having an impulse communicated to it by the subjacent artery.

These tumors, if left to themselves, never undergo spontaneous cure, but they either increase in size until the integument covering them sloughs and ruptures, or the external wound which had been temporarily plugged by coagulum, gives way; or else they inflame and suppurate, pointing at last like an abscess, and when bursting, giving rise to a sudden gush of blood, which may at once, or by its rapid recurrence, prove fatal. In some cases, a subcutaneous breach is made in the coagulated and plastic boundary, and the blood becoming infiltrated into the cellular tissue of the limb or part, gives rise to syncope, gangrene, and death.

The treatment of these cases must be conducted on precisely the same plan as that of an injured artery communicating with an external wound, the only difference being, that in the case of the diffused traumatic aneurism, the aperture in the artery opens into an extravasation of blood instead of upon the surface. We must especially be upon our guard not to be led away by the term *aneurism* that has been applied to these cases, and not to treat such a condition, resulting from wound, by the means that we employ with success in the management of that disease. In a pathological aneurism the blood is contained within a sac, which, as will hereafter be shown, is essential for the occurrence of those

changes that are necessary for the cure of the disease. In the diffused traumatic aneurism there is no sac, properly speaking, and hence these changes to which a sac is necessary, cannot take place. I doubt whether there is a case on record in which the Hunterian operation for aneurism, applied to the condition now under consideration, has not terminated in danger or death to the patient, and in disappointment to the surgeon.

The proper treatment of these cases consists in laying open the tumor by a stroke of the scalpel, removing the coagula, dissecting out the artery, and ligaturing it above and below the wound in it. This operation, easy in description, is most difficult and tedious in practice. The bleeding is often profuse, the cavity that is laid open is large, ragged, and partially filled with coagula. It is with much difficulty often that the artery is found under cover of these, and in the midst of infiltrated and disorganized tissues, and when found it is not always easy to get a ligature to hold. In performing this operation, the artery must, if possible, be compressed between the tumor and the heart; if it cannot be so commanded, the surgeon must be ready to apply his finger to the wound in the artery at the moment that the sac is laid open, in order to arrest the gush of blood that takes place from the open orifice. The application of a ligature to the distal end of the vessel, if completely divided, is especially difficult. Here the application of the actual cautery, or pressure, by means of a spongetent, or graduated compress, will be found the best means of arresting the hemorrhage.

2nd. The *circumscribed traumatic aneurism* differs entirely from the diffused in its pathology and treatment, inasmuch as it possesses a distinct sac.

There are two varieties of this form of aneurism; in the first, a puncture is made in an artery, or the vessel is ruptured subcutaneously, as perhaps in the reduction of an old dislocation, an extravasation of blood takes place into the tissues in the neighborhood of the wound, and if there is an external aperture, this cicatrizes. The blood that is extravasated becomes surrounded and limited by a dense layer of plastic matter poured out into the areolæ of the neighboring tissues, and forming a distinct circumscribed sac, which is soon lined by layers of fibrine deposited from the blood that passes through it. This tumor, usually of moderate size, and of tolerably firm consistence, pulsates synchronously with the beat of the heart, and has a distinct bruit, both of which cease when the artery leading to it is compressed. This form of circumscribed traumatic aneurism most commonly occurs from punctured wounds of small arteries, as the temporal, plantar, palmar, radial, and ulnar.

The treatment to be adopted depends upon the size and situation of the artery with which the tumor is connected. If the artery be small, and so situated that it can be opened without much after-inconvenience to the patient, as on the temple or in the fore-arm, it should be laid open, the coagula turned out, and the vessel ligatured above and below the wound in it. If the tumor be so situated, as in the palm, that it would be difficult and hazardous to the integrity of the patient's hand to lay it open, the Hunterian operation for aneurism should be performed, as was successfully done in the case (Fig. 73) in which the brachial was ligatured for an aneurism of this kind in the ball of the thumb, following serious injury to the hand from a powder-flask explosion.

Fig. 73.

It is but rarely that this form of traumatic aneurism is connected with a large artery; when it is, the vessel may be ligatured above, but close to the sac, in the same way as in the

next variety. If this form of traumatic aneurism have increased greatly in bulk, so that the skin becomes thin and discolored, or inflammation ensues, and symptoms of impending suppuration take place around it, then it would be useless to ligature the artery above the tumor, as this would certainly give way, and secondary hemorrhage ensue. Here the proper course is to lay open the sac, turn out the contents, and ligature the artery above and below the part that is wounded.

The next form of circumscribed traumatic aneurism is of rare occurrence, and usually arises from a small puncture in a large artery, as the axillary or the carotid. This bleeds freely, but the hemorrhage being arrested by pressure, the external wound and that in the artery close. The cicatrix in the artery gradually yields, forming, at the end of weeks or months, a tumor which enlarges, dilates, and pulsates eccentrically, with distinct bruit, having all the symptoms that characterize an aneurism from disease, and having a sac formed by the outer coat and sheath of the vessel. It is at first soft and compressible on being squeezed, but becomes harder and firmer, and cannot be so lessened after a time. It consists of a distinct circumscribed sac, formed by the dilatation of the cicatrix in the external coat and sheath of the artery, no blood being effused into the surrounding tissues. The treatment in these cases consists of the ligature or compression of the artery leading to the sac, in accordance with the principles that guide us in the treatment of aneurism from disease; though from the healthy state of the coats of the vessel, the artery may be ligatured as near as possible to the sac.

ARTERIO-VENOUS WOUNDS.

The wound in the artery may communicate with a corresponding one in a contiguous vein, giving rise to two distinct forms of disease — *aneurismal varix* and *varicose aneurism*. These preternatural communications, which were first noticed and accurately described by W. Hunter, most commonly happen at the bend of the arm, as a consequence of the puncture of the brachial artery in bleeding, but they have been met with in every part of the body in which an artery and vein lie in close juxta-position, having been found to occur as a consequence of wounds of the subclavian, radial, carotid, temporal, iliac, femoral, popliteal, and tibial arteries. The two forms of disease to which the preternatural communication between arteries and veins give rise, differ so completely in their nature, symptoms, effects, and treatment, that a separate consideration of each is required.

1st. *Aneurismal varix* results when a contiguous artery and vein having been perforated, adhesion takes place between the two vessels at the seat of injury, the communication between them continuing pervious, and a portion of the arterial blood being projected directly into the veins at each beat of the pulse. Opposite to the aperture of communication between the two vessels, which is always rounded and smooth, the vein will be found to be dilated into a fusiform pouch, with thickened coats. The veins of the part generally are considerably enlarged, somewhat nodulated, tortuous, and thickened. The artery above the wound is dilated; below it is usually somewhat contracted. These pathological conditions are evidently referable to a certain quantity of the arterial blood finding its way into the vein, and distending and irritating it by its presence and pressure, and less consequently being conveyed by the lower portion of the artery.

The symptoms consist of a tumor at the seat of injury, which can be emptied by pressure upon the artery leading to it, or by compressing its walls. If subcutaneous, this tumor is of a blue or purple color, of an oblong shape, and will be seen to receive the dilated and tortuous veins. It will be found to pulsate distinctly with a tremulous jarring motion, rather than a distinct impulse

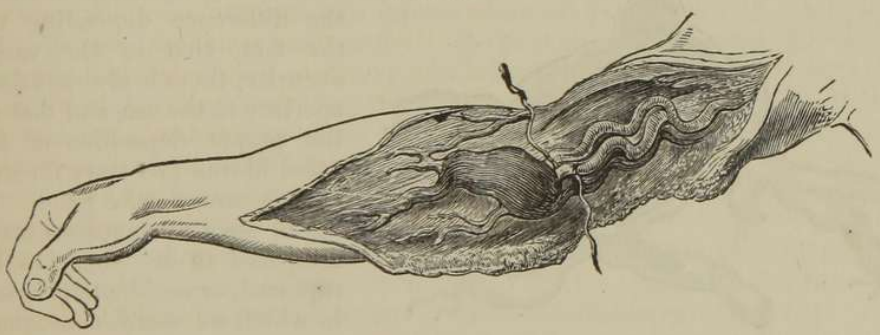
Auscultation detects in it a loud and blowing, whiffing, rasping or hissing sound, usually of a peculiarly harsh character. This sound has very aptly been compared by Porter, to the noise made by a fly in a paper bag, and by Liston, to the sound of distant and complicated machinery. The thrill and sound are more distinct in the upper than in the lower part of the limb, and are most perceptible if it be allowed to hang down so as to become congested. Besides these local symptoms, there is usually some muscular weakness and diminution in the temperature of the part supplied by the injured artery.

As this condition, when once formed, is stationary, all operative interference should be avoided, an elastic bandage merely being applied. Should a case occur in which more than this is required, the artery must be cut down upon and ligatured on either side of the wound in it.

2d. *Varicose Aneurism.* — In this case the opening in the artery and vein do not directly communicate (see Figs. 75 and 77), but an aneurismal sac is formed between the two vessels into which the blood is poured before passing into the vein.

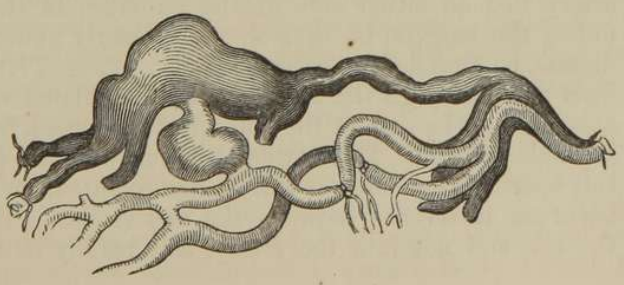
The pathological condition of this form of injury consists of a circumscribed false aneurism, communicating on one side with the artery, and on the other with the vein which is always in a state of varix, as represented in the annexed cuts from drawings of Sir C. Bell's, in the Museum of University College, representing a varicose aneurism before and after it has been opened (Figs. 74 to 76). In this case there appears to have been a high division of the brachial and a communicating branch below the wound, between the radial and ulnar, in consequence of which, as Mr. Shaw informs me, the tumor pulsated as forcibly after the operation as before, the blood finding its way back through the aneurism into the veins, caused gangrene of the hand and arm.

Fig. 74.



In the symptoms of varicose aneurism, we have a combination of the characters of aneurismal varix, and of the circumscribed traumatic aneurism; there is a pulsating tumor, at first soft and compressible, but after a time, assuming a more solid consistence, in consequence of the deposition of fibrine within it; above this tumor, the vein that has been punctured is dilated into a fusiform pouch, presenting the ordinary characters of varix. The sounds heard in these tumors are of two distinct kinds: there is the peculiar buzzing thrill that always exists where there is a preternatural communication between an

Fig. 75.



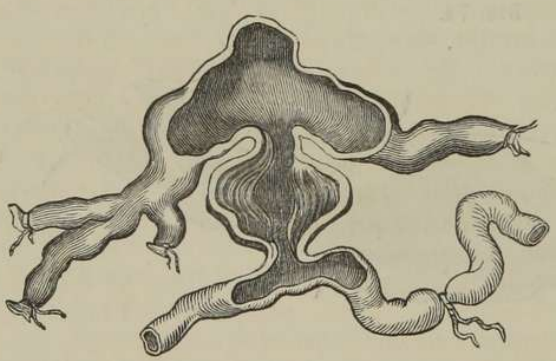
artery and vein; besides this, there is a blowing or bellows sound dependent on the aneurismal disease. These signs are most perceptible when the limb is

Fig. 76.

in a dependent position, and the sounds can often be heard in the veins at a considerable distance from the seat of injury. There is also some impairment in the nutrition and temperature of the parts supplied by the injured vessels. As the disease advances, the aneurismal tumor lying between the artery and vein continues to increase in size, and to become hardened by the deposition of laminated fibrine. If left to itself, it would probably continue to enlarge until sloughing of the integuments covering it, followed by hemorrhage, took place. In some cases, the aperture of communication between the vein and sac becomes closed, and the aneurism is converted into one of the false, circumscribed variety.

The treatment of this disease must be conducted on different principles from those that have been laid down as required in the ordinary circumscribed traumatic aneurism; the difference depending upon the fact, that in the varicose aneurism there is always a double aperture in the sac, and that thus the proper deposition of laminated fibrine necessary for its occlusion cannot take place. The sac of such an aneurism may be compared to one that has been ruptured, or accidentally opened, in which we could consequently not expect the occurrence of those changes that are necessary for the cure of aneurism by the Hunterian operation.

Fig. 77.



In a varicose aneurism, consequently, the sac must be freely incised, and the artery tied on either side of the puncture in it. Now this procedure may, unless the surgeon be careful, and properly understand the pathology of this disease, be attended by some difficulty. (Fig. 77.) After the first incision has been made through the integuments, the dilated vein will be laid open, and an aperture will be seen at the bottom of the vessel, from which arterial blood may be made to issue. If an attempt be made to find the artery immediately below this aperture, the surgeon will be disappointed, for the sac of the circumscribed aneurism intervenes between the two vessels. That this aperture leads into the sac, and not into the artery, may readily be ascertained by introducing a

Note.—Figs. 74 and 75 represent a varicose aneurism at the bend of the arm unopened. Figs. 76 and 77, the same tumor laid open, showing the circumscribed false aneurism between the two vessels.

probe into it, which will be seen to be capable of being carried sideways, as well as upwards and downwards, to a considerable extent, and in different directions, altogether out of the course of the artery. In order to expose this vessel properly, a probe-pointed bistoury must be introduced into this opening, and the sac of the false aneurism slit up to its full extent, the coagula turned out, and the puncture in the artery sought for at the bottom of the cavity that has been exposed; this may now readily be made visible by the escape of a jet of arterial blood on relaxing the pressure on the upper part of the artery; a ligature must then be passed above and below the wound, and the cavity lightly dressed with lint.

ACCIDENTS AFTER LIGATURE.

The accidents that may follow the application of the ligature to wounded arteries are, *secondary hemorrhage*, and *gangrene of the limb*.

By *Secondary or Recurrent Hemorrhage*, is meant bleeding from any cause after the application of a ligature. This accident may arise from a variety of circumstances, which may be divided into two great classes: — 1st, those that are dependent upon the vessel or ligature; and 2d, those that are connected with some morbid condition of the constitution or of the blood, in consequence of which those changes which are necessary for the occlusion of the artery do not take place.

Amongst the first class of causes may be mentioned any imperfection in the application of the ligature; as, for instance, its being tied too loosely, or with the inclusion of a portion of nerve, vein, or muscle; so also the accidental puncture of the artery above the point to which the ligature is applied.

The rush of blood through a neighboring trunk, or collateral branch immediately above the ligature, has been considered as likely to interfere with the formation of the internal plug; but too much importance should not be attached to this, for Porter has tied the carotid successfully within one-eighth of an inch of the brachio-cephalic artery. Bellingham has ligatured the external iliac close to its origin; and Key, the subclavian in the vicinity of a large branch, without secondary hemorrhage ensuing. I think, however, that the presence of a collateral branch in close proximity to the *distal* side of the ligature — more especially if it be one that serves to carry on the anastomosing circulation — will be found to have a decided tendency in preventing the formation of an internal coagulum.

The wound of a collateral branch immediately above the ligature, though it do not give rise to troublesome hemorrhage at the time, will, as I have seen, cause furious bleeding as the collateral circulation becomes established.

A diseased state of the coats of the artery at the point deligated, will occasion rapid sloughing and unhealthy ulceration of the vessel; those plastic changes which are necessary for its occlusion not going on within it. It has happened that fatal secondary hemorrhage has occurred from a large artery, such as the femoral, in consequence of a small atheromatous or calcareous patch having given way immediately above the ligature a day or two after its application.

The constitutional causes of secondary hemorrhage act by preventing the formation of a clot within, and the deposit of plastic matter without, the artery; or if formed, causing their absorption in a few days. (Figs. 70 and 71.) Amongst the most common of these causes are those unhealthy states of the system in which inflammation of a diffused or erysipelatous character sets in, which is incompatible with plastic effusion. In these cases either no internal coagulum at all is formed, or if any is deposited it is weak, imperfect, and unable to resist the impulse of the blood; or if it have already formed, it speedily becomes absorbed or disintegrated, offering no resistance to the impulse of the blood, and being washed away.

The occurrence of erysipelas, phlebitis, or sloughing of the stump or wound,

will prevent or arrest the necessary adhesive inflammation. Besides these conditions, there are certain states of the blood in which from disease, as albuminuria, it has lost its plasticity, and cannot yield the products of adhesive inflammation. Secondary hemorrhage is especially apt to occur in cases of pyemia, provided that disease assume a somewhat chronic character. The conditions of the blood in pyemia being incompatible with the formation of a firm and plastic coagulum within the artery, the vessel continues or becomes open, and secondary hemorrhage will certainly occur.

The occurrence of secondary hemorrhage is usually somewhat gradual, and not without warning. The blood does not burst forth in a gush at once, but appears at first in a small quantity oozing out of the wound and staining the dressings; it may then cease to flow for a time, but breaks out again in the course of a few hours, welling-up freely in the wound, and either draining the patient by repeated losses, attended by the phenomena that characterize hemorrhagic fever, or else exhausting him so that he falls a victim to some asthenic disease, such as pneumonia, erysipelas, or phlebitis. In other cases again, after a few warnings, it may burst out in a gushing stream that at once destroys life.

The opportunities that I have had of examining the state of the vessels in several cases of fatal secondary hemorrhage, lead me fully to concur with Guthrie and Porter, that the blood in the great majority of instances comes from the distal, and not from the proximal, side of the wound. The greater tendency in the distal end of the vessel to bleed, appears to arise partly from the less perfect occlusion of this portion of the artery, and partly from its greater liability to slough, in consequence of the ligature interrupting its supply of blood through the vasa-vasorum. It is no objection to this opinion that the fatal hemorrhage is often of an arterial character; for, though it is true that the blood which is carried to the distal end, is, for the first few days after the application of a ligature, of a venous hue; yet after the collateral circulation is once established, it gradually assumes a more scarlet tint, and at last becomes completely arterialized.

Secondary hemorrhage may come on at any time between the application of the ligature and the closure of the wound. There are, however, three periods at which it is particularly apt to occur: — 1stly, a few days after the ligature has been applied; 2dly, about the period of the separation of the ligature; and 3dly, at an indefinite time after its separation.

The hemorrhage which occurs a few days after the application of the ligature, arises, either from some imperfection in the tying of the ligature; from disease in the arterial coats, causing them to give way; or from want of adhesive inflammation on the face of a stump: when from the latter cause, there is a general oozing or dribbling of blood from many points of the surface rather than a gush from one orifice. In those cases in which the artery has been tied above the wound only, hemorrhage is very apt to occur at this time.

When hemorrhage occurs about the time of the separation of the ligature, it may arise from any of the causes already specified that interfere with the due formation of an internal coagulum, or that occasion sloughing of the coats of the vessel.

Lastly, in some cases in which the ligature has separated, but the wound has remained open, the hemorrhage may take place either from the cicatrix in the artery being too weak to support the impulse of the blood; or from the coagulum being obsorbed in the way already mentioned. The continuance of the open state of the wound after the separation of the ligature, is, I think, not improbably dependent upon a morbid condition of the coats of the vessel, which eventually leads to hemorrhage. The length of time that will sometimes elapse between the separation of the ligature and the occurrence of hemorrhage is very remarkable thus there is a preparation in St. Thomas's Hospital of a carotid

artery from which secondary hemorrhage took place in the tenth week after ligature; and South mentions a case of ligature of the subclavian, in which the thread separated on the twenty-seventh day, the fatal hemorrhage occurring in the thirteenth week.

The *Treatment of Secondary Hemorrhage* must be considered, as the bleeding takes place; 1stly, from a stump;—and 2dly, from an artery tied in its continuity.

In all cases of ligature of arteries, care should of course be taken to prevent, if possible, this accident, by keeping the patient perfectly quiet, giving no stimulants, having the bowels kept open, and the secretions free, and avoiding any undue traction on the ligature itself.

1stly, The treatment of secondary hemorrhage *from a stump* will depend in a great measure on the degree of union that has taken place between the flaps.

When the hemorrhage occurs a few days after amputation, if there be but slight oozing, elevating the part, applying cold, and bandaging it with a roller, so as to compress the flaps, will sometimes arrest the bleeding. If it continue, however, or become more severe, the flaps which will have been disunited by the effusion of blood, must be separated, and the bleeding vessels sought for and tied. In some cases the ligatures will not hold; under these circumstances the application of the actual cautery will arrest the flow of blood. If the oozing appear to be pretty general from a number of points, the flaps being somewhat spongy, I have succeeded in arresting the hemorrhage by clearing their surfaces thoroughly of all coagula, and then bringing them tightly together by means of a roller.

If the hemorrhage occur at a later period, after the eighth or tenth day, when tolerable union has taken place, and appears to proceed from the principal artery of the part, an effort may be made to arrest it by the application of the horse-shoe tourniquet, which occasionally will stop all further loss of blood; or, if the union that had taken place between the flaps has been broken through, the stump may be fairly opened up, the coagula turned out, and the bleeding vessel sought for and tied. If, however, several weeks have elapsed, or if, notwithstanding the hemorrhage, the union between the flaps continues sound and firm, then the choice lies between ligaturing the artery in the stump itself, by making a fresh incision, or continuing the old one up; or else in ligaturing the artery at some distance above the stump. I prefer the former method, as in this way the surgeon is led directly to the open and bleeding vessel, and the patient escapes the dangers of a second formal operation. But if this cannot be done, it will be necessary to tie the main artery of the limb just above the flaps, or wherever it can be most readily reached; thus, in amputation of the leg, the superficial femoral may be ligatured; after removal of a thigh, the same artery, or the external iliac; and in disarticulation of the arm at the shoulder-joint, the subclavian artery must be tied, either above or just below the clavicle.

2dly. When the hemorrhage occurs after a ligature has been applied *to the continuity of the vessel*, whether for injury or disease, pressure must first be tried. With this view the wound should be plugged, and a graduated compress should be very firmly and carefully applied by means of a ring tourniquet over the point from which the blood proceeds, which in this way may occasionally be stopped. Not unfrequently, however, this will prove ineffectual, the bleeding recurring from underneath it. When this is the case, what course should the surgeon pursue? He may re-apply the compress once more with great care, after clearing away coagula, and drying the parts thoroughly; but should it again fail in arresting the bleeding, it is useless to trust to it again, as the hemorrhage will certainly recur, and valuable time and much blood will be lost in these fruitless attempts at checking it. The course that the surgeon should pursue in such a case as this, is a most anxious consideration, but one on which

his mind should be clearly and decidedly determined, as there is but little time for reflection or consultation, and none for referring to authorities.

If the artery be situated on the trunk, as the subclavian, carotid, or one of the iliacs, there is nothing to be done but to trust to the plugging of the wound, and in the great majority of these cases the patient will die exhausted by repeated hemorrhage.

When the artery is situated in one of the limbs, more efficient procedures may be had recourse to. If it be one of the arteries of the upper extremity, the wound should be opened up, and an attempt made to tie both ends of the vessel again in this; should this fail, or not be practicable, the artery must be deligated at a higher point than that at which it had been previously tied; should the hemorrhage still continue, or be re-established, amputation is the only resource left.

In the lower extremity, the treatment of this form of secondary hemorrhage renders the case replete with difficulty. Here I believe it to be useless to tie the artery at a higher point than that to which the ligature has been already applied, as gangrene invariably follows this double ligature of the arteries of the lower extremity: at least in the two or three cases that I have seen in which this practice has been had recourse to, mortification of the limb has ensued; and in all the reported cases with which I am acquainted, a similar result has occurred. Under these circumstances, therefore, I should be disposed to recommend the surgeon to cut down on the bleeding part of the vessel, treating it as a wounded artery, and applying a ligature above and below the part already deligated; an operation that would necessarily be fraught with difficulty. Should this be impracticable, or not succeed in checking the hemorrhage, I think that we should best consult the safety of the patient by amputating at once on a level with the ligature. Although this is a severe measure, it is infinitely preferable to allowing him to run the risk of the supervention of gangrene, which will require removal of the limb under less favorable conditions. If the hemorrhage occur from a wounded artery, to which ligatures have already been applied above and below the seat of wound, the same treatment must be adopted as in those cases in which the bleeding takes place from the application of the ligature to the continuity of the vessel.

GANGRENE FOLLOWING LIGATURE.

After the ligature of the main artery of a limb, the collateral circulation is under all ordinary circumstances, sufficient to maintain the vitality of the part supplied by the deligated vessel. In some cases, however, it happens that the condition of the circulation in the parts below the ligature is not compatible with their life. The occurrence of gangrene in this way is influenced by the age of the patient, the seat of the operation, and the various conditions in which the limb may afterwards be placed.

The influence of age is not, however, so marked as might be supposed; for although there can be no doubt that there is a less accommodating power in the arterial system to varying quantities of blood at an advanced period of life, and that there would be greater difficulty in maintaining the vitality of the limb after ligature of the artery in a man of sixty than in one of twenty-five; yet I find, that of thirty cases in which gangrene of the lower extremity followed the ligature either of the external iliac or femoral arteries, that the average age of the patient was thirty-five years, as nearly as possible the mean age at which these operations, according to Norris's Tables, are generally performed. Of these cases of gangrene, 2 occurred under twenty years of age, 11 between twenty and thirty, 8 between thirty and forty, and 9 above forty.

The seat of the operation influences greatly the liability to gangrene, which is

much more frequent after the ligature of the arteries in the lower, than in the upper extremity.

Besides these predisposing causes, gangrene after ligature may be directly occasioned by a deficient supply of arterial blood.

In some cases this may arise from the collateral vessels being unable, in consequence of the rigidity of their coats, to accommodate themselves to the increased quantity of blood they are required to transmit; or they may be compressed in such a way by extravasation as to be materially lessened in their capacity. In other instances again, the existence of cardiac disease may interfere with the proper supply of blood to the part.

Great loss of blood, either in consequence of secondary hemorrhage, or in any other way, before or after the application of the ligature, is often followed by gangrene, and is almost certain to be attended by this result if a second ligature has been applied to a higher point in the lower extremity. That a diminution in the quantity of blood circulating in the system may, under the most favorable circumstances, become a cause of gangrene after the ligature of the artery, is illustrated by the statement of Hodgson, that soon after the introduction of the Hunterian operation into Paris, it was the custom to employ repeated venesection in the cases operated on, the consequence of which was that mortification was of frequent occurrence.

A more common cause of gangrene is the difficulty experienced by the venous blood in its return from the limb. This difficulty always exists even when no mechanical obstacle impedes its return, being dependent on the want of a proper *vis à tergo* influence to drive it on. The propulsive power of the heart, which is the main agent in the venous circulation, is greatly diminished by being transmitted through the narrow and tortuous channels of the anastomosing vessels. This difficulty to the onward passage of the venous blood may, if there exist any cause of obstruction in the larger venous trunks, be readily increased to such an extent as to choke the collateral circulation, and so cause the limb to mortify. This mechanical obstacle may be dependent upon the occlusion of the vein by inflammation excited within it opposite the ligature, by its transfixion with the aneurism needle, or by its accidental wound with the knife in exposing the artery. When such an injury, followed by inflammation, is inflicted on a vein, which, like the femoral, returns the great mass of blood from a limb, gangrene is the inevitable result.

The supervention of erysipelas in the limb after the application of the ligature, though fortunately not of very frequent occurrence, is a source of considerable danger, being very apt to give rise to gangrene by the tension of the parts obstructing the anastomosing circulation I have in this way, on two occasions, seen gangrene of the fingers follow the ligature of the vessels of the forearm.

The abstraction of heat from the limb, either directly by the application of cold, or indirectly, by the neglect of sufficient precaution to keep up the temperature of the part, often occasions gangrene: thus Sir A. Cooper has seen mortification follow the application of cold lead lotion, to a limb in which the femoral artery has been tied; and Hodgson has witnessed the same result when the operation was performed at an inclement season of the year.

The incautious application of heat may, by over-stimulating the returning circulation of the limb, especially about that period when the rising temperature is an indication of increased action in the capillary vessels, occasion mortification. In this way the application of hot bricks and bottles to the feet have given rise to sloughing; and Liston was compelled to amputate the thigh after ligature of the femoral artery, for gangrene, induced by fomenting the limb with hot water.

The application of a bandage, even though very cautiously made, is apt to induce sloughing and gangrene. I have seen this happen when a roller was

applied to the leg after ligature of the femoral, with a view of removing the œdema.

The period of supervention of gangrene of the limb extends over the first three or four weeks after the ligature of the vessel. It seldom sets in before the third day, but most frequently happens before the tenth.

The gangrene from ligature of an artery is almost invariably of the moist kind, on account of the implication of the veins. The limb first becomes œdematous, vesications then form, and it assumes a purplish or greenish black tint, rapidly extending up to the seat of operation. In some cases, though they are rare, simple mummification of the limb comes on, the skin assuming a dull yellowish-white hue, mottled by the streaks that correspond to the veins, and becoming dry, horny, and shrivelled, about the extensor tendons of the instep.

Treatment of Gangrene following Ligature. — Much may be done with the view of preventing this. Thus: the limb should be elevated, wrapped up loosely in flannel or cotton wadding, and laid on its outer side after the operation. If the weather be cold, hot water bottles may be put into the bed, but not in contact with the limb. Should there be any appearance of stagnation of venous blood, the plan recommended by Mr. Guthrie of employing continuous and methodical frictions in a direction upwards for twenty-four hours, so as to keep the superficial veins emptied, may be practised.

When mortification has fairly set in, amputation of the limb should be had recourse to at once as the only chance of saving life, in all those cases in which the patient's constitutional powers are sufficiently strong to enable him to bear the shock of the operation. The limb should be removed at the seat of the original wound, or opposite the point at which the artery has been tied. In those cases, however, in which the gangrene follows injury of the femoral artery just below Poupart's ligament, Guthrie advises the amputation to be done below the knee, where it usually stops for a time. If the gangrene spread, with œdema or serous infiltration of the limb, the amputation should be done high up;—at the shoulder-joint, or in the upper-third of the thigh. In these cases a large number of vessels usually require ligature, having been enlarged by the collateral circulation.

CHAPTER XII.

WOUNDS OF SPECIAL ARTERIES.

Carotid.—Wounds of the carotid artery, and of its primary and secondary divisions, are of more frequent occurrence in civil practice than similar injuries of any other set of arteries in the body, in consequence of the neck being so frequently the seat of suicidal attempts. The hemorrhage from wounds of the main trunk is so copious as often to be immediately fatal. In the event of a surgeon being at hand, both ends of the bleeding vessel must be at once ligatured. In consequence of the speedy fatality of wounds of the carotid artery and of its primary branches, traumatic aneurisms are rarely met with in this situation; they do, however, occasionally occur, and the records of surgery contain at least five instances of this kind, in all of which the common carotid was tied, and the patient ultimately recovered.

Aneurismal Varix of the internal jugular vein dependent on punctures of it, or of the carotid artery, usually the result of sword-thrusts in the neck, are

apparently of more frequent occurrence than traumatic aneurism in this region; probably owing to the close proximity of the vein rendering it difficult for the artery to be wounded on the outer or anterior sides, without first perforating that vessel. The symptoms presented by these cases, though offering the general characteristics of aneurismal varix, yet have several points that are worthy of special remark. The wound of the vessels was in every instance followed by the effusion of a large quantity of blood into the loose cellular tissues of the neck; the extravasation acquiring even the size of a child's head, and threatening immediate suffocation. As this extravasation subsided, the ordinary characters of aneurismal varix began to manifest themselves. The period at which these symptoms first made their appearance, varied somewhat in the different cases, but they always occurred within four or five days of the receipt of the injury. In none of the cases did the disease appear to shorten life, or to have occasioned any dangerous or inconvenient effects, with the exception of some difficulty in lying on the affected side, and occasional giddiness or noise in the head on stooping.

Varicose aneurism does not appear to have been met with in this situation. No operation is admissible in these affections.

Traumatic aneurisms of the *temporal* artery, and of its branches, occasionally occur as the result of partial division of these vessels in cupping on the temple; two cases of this kind I have met with, in both of which the disease was readily cured by laying the tumor open, turning out its contents, and tying the artery on either side of it.

Subclavian.—A wound of the subclavian artery may almost invariably be looked upon as fatal, though in consequence of the manner in which it is protected by the clavicle these injuries can scarcely occur except from gun-shot violence. From the rapidly fatal nature of wounds of the subclavian artery, traumatic aneurisms in this situation are not met with; but when the artery passes into the axilla below the margin of the first rib, they are not of unfrequent occurrence. Aneurismal varix of the subclavian vein resulting from wound of the artery in this situation, has, however, been seen, notwithstanding the separation that exists between the two vessels until they reach the acromial angle of the subclavian space. These injuries have likewise usually been the result of sword-thrusts, and do not admit of any surgical interference.

Axillary.—In open wounds of the axillary artery, and of its branches, the rule of practice consists, in cutting down upon the bleeding vessel wherever it may be situated, and ligaturing it on either side of the wound. It must be borne in mind, that the arterial branches given off between the lower edge of the first rib, and the fold of the axilla being very numerous, a punctured wound of the axilla or side of the chest may injure one of these vessels, though from its course, and the free flow of arterial blood that has followed the stab, it may be supposed that the axillary artery itself has been punctured. The particular vessel injured can only be ascertained by following up the wound and ligaturing the artery that furnishes the blood.

In some cases, however, the state of the parts may be such, that it may be impossible to trace the artery at the depth at which it is situated, or even to expose it in a mere superficial situation, as in the stump after amputation at the shoulder-joint. Under these circumstances, the rule of surgery, of ligaturing an artery at the seat of injury, may be departed from, and the main trunk should be tied either above or below the clavicle; and the success of this operation has been sufficient to justify our having recourse to it rather than exhaust the patient by any prolonged attempts at the ligature of the vessel in the open wound, though I think that this ought first to be attempted. Of 15 cases in which the artery has been ligatured either above or below the clavicle, for hemorrhage from wounds in the axilla or from stumps, I find that 9 were cured and 6 died. Although the success is about equal in whichever situation the

vessel be tied, I should certainly give the preference to the supra-clavicular operation, owing to the greater facility of its performance, and the comparative absence of collateral branches at the seat of ligature. In some cases, however, especially after amputations at the shoulder, the clavicle is pushed up at its acromial end, and then the artery might be best reached below the clavicle, under or through the pectoral muscles.

Traumatic Aneurisms in the Axilla are not of unfrequent occurrence, arising directly from gun-shot wounds, or from the thrust of a knife, sabre, or other pointed weapon. In some cases the injury arises from a subcutaneous rupture of the vessel, the patient stretching out and straining his arm in an attempt to save himself from falling, and feeling a sudden snap in the axilla, which is followed by the formation of a rapidly diffused aneurism.

There are several cases on record in which axillary aneurism has resulted from violent attempts made by the surgeon in the reduction of old standing dislocations of the head of the humerus. Thus Pelletan mentions a case of this kind, in which the tumor being supposed to be emphysematous, was opened, and the patient perished of hemorrhage. Warren relates a case of diffused axillary aneurism resulting from rupture of the artery, in consequence of the surgeon attempting to reduce a dislocation of the humerus by using his foot as a fulcrum in the axilla, but without taking off his boot. Gibson has related three cases of axillary aneurism following rupture of the artery, in the attempt to reduce old standing dislocations with the pulleys. These cases are of much interest to the surgeon, as showing the necessity for great caution in the use of powerful extending force in the reduction of old dislocations, adhesions having probably formed between the artery and head of the bone.

Some of these traumatic axillary aneurisms have a tendency to diffuse themselves with great rapidity, filling up the whole of the hollow of the armpit, and extending under the pectorals, even up around the shoulder. In other cases again, when more circumscribed, the disease may get well spontaneously, as happened in cases recorded by Van Swieten, Sabatier, and Hodgson. In other instances again, the disease has remained stationary for years, or has even undergone spontaneous cure. It cannot however be considered sound practice to leave a traumatic aneurism of this artery without surgical interference, after the ordinary dietetic and hygienic plans of treatment have failed in effecting a cure, for it may at any time become rapidly diffused, or inflame and suppurate.

The treatment of traumatic axillary aneurism must have reference not only to whether it is diffused or circumscribed; but if diffused, whether it be of recent origin, or have originated from puncture or subcutaneous rupture of the vessel.

When a *diffused* traumatic aneurism of recent origin, rapid formation, and dependent upon puncture of the artery, is met with in the axilla, the treatment must be conducted in the same way as that of a wounded artery, without extravasation, in this situation. The tumor should be laid open, the artery sought for, and, if possible, ligatured where wounded. If this be impracticable, it may be deligated above the clavicle. There is, however, the danger after this operation, either of secondary hemorrhage coming on from the seat of wound, by blood conveyed through the collateral vessels, which open into the subscapular and circumflex arteries; or else, of the limb falling into a state of gangrene. In either case amputation at the shoulder and through the aneurismal extravasation is the only practice that can be had recourse to.

In those cases of diffused traumatic aneurism of the axilla that arise from subcutaneous rupture of the artery, the condition of parts is essentially the same as in a case of punctured wound of the vessel, with the exception of the existence of no external aperture in the integuments. In these cases there is a tumor of considerable size, hard or fluctuating, according to the state of coagulation of its contents, with thrill, pulsation, & gushing, hot sensation,

much œdema of the arm, tendency to inflammation, suppuration, and gangrene of the sac.

In such a case the choice would lie between treating the injury as that of a wounded artery, by direct incision, or ligaturing the vessel above the clavicle. The first plan, by direct incision, has never to my knowledge been practised, and would present so many difficulties as scarcely to be a justifiable procedure. The ligature of the vessel above the clavicle has been done three times, and of these only one recovered, two of the patients dying of gangrene and secondary hemorrhage. In the successful case, secondary hemorrhage had occurred, and gangrene of the arm, which threatened, was prevented, and the patient saved, by having amputation at the shoulder-joint performed.

Circumscribed traumatic aneurisms of the axillary artery are not uncommonly of slow formation, existing for several months or years before they require operation, although resulting from punctured wound of the armpit. In chronic cases such as these, the aneurism is necessarily provided with a firm and distinct sac, and approaches closely in its characters to the pathological form of the disease. The treatment here cannot be conducted on the principles that guide us in the management of a wound, or of a diffused aneurism of recent occurrence of this artery; for not only is the circumscribed aneurism provided with a sac, but the vessel, at the point injured, would very probably be found to have undergone changes that would render it little able to admit or to bear the application of the ligature. It would be softened, thickened, and lacerable, with perhaps a wide funnel-shaped aperture leading into the sac, which would be closely incorporated with the neighboring parts. But indeed the treatment of this form of circumscribed traumatic aneurism by the ligature of the artery on the proximal side of the sac, has been found to be attended with remarkable success. In eight recorded cases in which this operation has been performed, not one fatal result has been noted. In all, the aneurism arose from stabs or gun-shot wounds, and had existed for various periods, between two weeks and four years. In four of the cases the artery was ligatured above, and in four below, the clavicle; and in one case of each category there was suppuration of the sac.

The particular point at which the artery should be ligatured must depend upon the condition of the tumor. If this be of large size, or arise from the upper part of the axillary artery above or immediately below the pectoralis minor muscle, there is no choice but to deligate the vessel above the clavicle. Should, however, the principal increase in the tumor take place in a direction downwards and forwards under the great pectoral muscle, the portion of the artery immediately below the clavicle appearing to be free from disease, the question would arise as to whether this part might not be selected for the application of the ligature; and as the results of both operations have hitherto been equally favorable, this must rather be determined by the peculiarities in each case, than on more general grounds. Most surgeons, I think, would however prefer ligaturing the artery above the clavicle, as being a simpler proceeding, than tying it below that bone; which, moreover, has the disadvantage of bringing the scalpel into very close proximity with the sac, which, were it to stretch upwards under the pectoralis minor to a greater extent than could be discernible externally, might possibly be opened by the knife, as has even happened in operating above the clavicle. It has been recommended to apply the ligature between the sac and the origins of the sub-scapular, and posterior circumflex arteries, above the former and below the latter; but this is an anatomical impossibility if the aneurism be situated above the lower border of the axilla.

Compression of the artery on the distal side of the tumor has succeeded in curing the disease in a case that was under Dr. Goldsmith, of Vermont.

The Brachial Artery and its Branches.—The hemorrhage from wounds of the brachial artery may sometimes be arrested by the employment of methodical compression, but usually it requires ligature in the ordinary way on each side of the aperture. This vessel may occasionally be the seat of traumatic aneurism, in consequence of a puncture received in venesection. This accident, which was formerly of frequent occurrence, when venesection was practised by professed phlebotomists, now very rarely happens. Should a surgeon be so unfortunate as to puncture the brachial artery in this way, he may prevent injurious after-consequences by keeping up a proper degree of pressure, by means of a graduated compress applied immediately on the occurrence of the accident. With this view, the fingers, hand, and fore-arm, having been very carefully padded and bandaged, a well-made graduated compress should be firmly applied over the seat of puncture, and retained there for at least ten days or a fortnight. Should the aperture in the artery not be closed in this way, either a circumscribed false aneurism, a varicose aneurism, or an aneurismal varix will form, according to its situation in relation to the vein.

In the *Circumscribed Traumatic Aneurism* at the bend of the arm, following a wound of the brachial artery, we have the usual soft or semi-solid pulsating tumor, which can readily be emptied on pressure, and possesses more or less bruit. This disease may be treated in one of three ways: by compression upon or above the tumor; by ligaturing the artery leading to it; or by cutting through the sac, and deligating the vessel on either side of the aperture in it.

The compression of the tumor has often been successfully practised. It may be done by means of a graduated compress, or the application of a ring tourniquet — the tumor becoming consolidated, and gradually undergoing absorption. Should this plan not succeed, we must be guided in our ulterior measures by the particular conditions of the case. If the tumor be of recent origin, soft and compressible; or, though of longer duration, large, with a thin sac, it should be treated by direct incision, and the artery be deligated on either side of the wound in it. Should, however, the tumor be small, or but of moderate size, and the sac be tolerably thick and firm, so as to admit of the deposit of laminated fibrine, we may treat it by deligation of the brachial artery, either in the middle of the arm, or, as Anel did with success, immediately above the tumor. In the event, however, of the disease not being cured in this way, incision of the sac must be had recourse to, as I have known to be necessary in a case in which the brachial artery was tied above the tumor, which was large, with a thin sac, the pulsations returning in a few days, and the tumor continuing to enlarge.

Varicose Aneurism, at the bend of the arm, presents the ordinary character of the disease. Occasionally, though rarely, it would appear that the aperture of communication between the aneurismal sac and the vein becomes closed, and thus the varicose is converted into the ordinary circumscribed traumatic aneurism.

The treatment of this affection must be conducted on different principles from that of the ordinary circumscribed variety, for whatever be the density of the sac, it is never, as has already been explained (p. 169), a perfect one, having always an opening into the vein which would prevent its proper closure by the deposit of laminated fibrin. In 4 cases related by Sabatier, which were treated by Anel's operation, amputation became necessary in 2, and in the other cases, the operation by incision of the sac was required before a cure could be effected. The sac must therefore be laid open, and the vessel tied on either side of it in the way that has been recommended in the treatment of that disease, and with the caution there laid down. If the varicose aneurism be converted, after a few days, into the circumscribed form, the aperture into the vein becoming occluded, the ligature of the artery above the sac may be successfully employed, or compression succeed in curing the disease.

In *aneurismal varix* of the arm, a roller and compress are all that can be required.

Arteries of the Fore-arm and Palm. — These vessels are very commonly wounded by pieces of glass, earthenware, or knife-cuts. In every case the bleeding-point must be cut down upon, and both ends of the vessel tied. This rule is peculiarly imperative in this situation, on account of the freedom of the anastomosis through the palmar arches. In many of these cases the bleeding is at first very free, but, being arrested by pressure, does not break out again until eight or ten days have elapsed, when, the arm being much infiltrated with blood, inflamed, and swollen, double ligature of the vessel, at the seat of injury, has to be practised under somewhat difficult and unfavorable circumstances.

Traumatic Aneurism of the Radial and Ulnar Arteries usually assumes the circumscribed form, owing to the pressure employed at the time of injury, confining the extravasation. If it be small and recent, and situated superficially at the lower part of the fore-arm, or if it be in any way diffused, the better plan is to cut down upon and through the tumor at once, ligaturing the vessel on either side. If, however, the aneurism be deeply seated amongst the mass of muscles at the upper part of the fore-arm, near the elbow joint, the wound having healed, and the soft parts covering it being healthy and firm, the advice given by Mr. Liston appears to be most judicious :—rather than cutting through the muscles, and detaching their connections, he recommends that the aneurism should be left to attain some consistence, and then that the brachial artery be secured in the mid-arm.

Wounds of the Palmar Arches not unfrequently occur from the breaking of glass or bottles in the hand, or stabs from some pointed instrument, and are always troublesome to manage. If the surgeon see the case shortly after the infliction of the wound, he might endeavor, by enlarging the aperture to a moderate extent, and with due attention to the tendons and nerves of the part, to secure, the bleeding vessel. Should he fail in doing this, which he certainly would if it be the deep arch that is injured, a graduated compress must be well and firmly applied from the bottom of the wound; and that artery above the wrist which appears most to correspond with the arch wounded, or better still, the brachial itself should be compressed with a ring tourniquet, or the elbow may be forcibly flexed, and cold assiduously applied. If the case be not seen until several days have elapsed, when secondary hemorrhage has occurred, and the palm has become infiltrated and swollen, pressure can no longer be borne upon the seat of injury, and it is useless to endeavor to search for the injured vessel in the midst of sloughy and infiltrated tissues, through a narrow wound which cannot be enlarged without danger of disorganizing the hand. Under these circumstances, it is necessary to deviate from the ordinary rule of practice in wounded arteries, and both arteries should be tied, immediately above the wrist; should hemorrhage occur after this, as might happen in the case of an enlarged interosseous artery, the surgeon must try compression or ligature of the brachial.

Circumscribed Traumatic Aneurism in the Palm is by no means of frequent occurrence. It may however follow wounds of the palmar arches. In such a case as this, it would be clearly out of the question to lay open the sac, and to search for the injured vessel in the midst of the aponeurotic and tendinous structures of the hand. It would consequently be necessary, either to tie the radial and ulnar arteries immediately above the wrist, or to ligature the brachial in the upper arm. The latter plan should be preferred; as, were the first mode of treatment put into practice, the sac might continue to be fed by the interosseous artery, as happened in a case of Roux's, in which the patient died of hemorrhage from the palmar aneurism after the ligature of both arteries of the fore-arm. In the case represented (fig. 73), Liston successfully ligatured the brachial in the mid-arm, after compression upon it had failed to effect a cure.

Femoral Artery and its Branches. — The hemorrhage from these arteries when wounded is always very profuse. In all cases, ligature of the wounded vessel should be practised at the seat of injury. If a *diffused* traumatic aneurism have already formed, the artery should be commanded by a tourniquet, as it passes over the brim of the pelvis, the sac laid open, and the bleeding vessel sought for and tied. Mr. Guthrie has collected a great number of cases, which prove incontestably that the general principles of treatment in wounded arteries must not be departed from, when the arteries of the groin or thigh are wounded. On the contrary, the facility with which in most cases the circulation is kept up, and the readiness with which secondary hemorrhage comes on as a consequence of the free anastomosis in this situation, renders the rule of practice of applying a ligature on both sides of the wound in the vessel peculiarly stringent in all recent arterial wounds in this part of the body. Secondary hemorrhage and gangrene of the limb are the great sources of danger here. When gangrene is imminent, or has come on, amputation is necessarily the sole resource. With regard to secondary hemorrhage, supervening after ligature of the artery *at the seat of injury*, there is, I think, no safe course but removal of the limb. Where the artery has been tied higher up, as for instance when the external iliac has been ligatured for recent wounds or traumatic aneurisms in the groin or upper part of the thigh, the hemorrhage appears to have returned, or gangrene to have supervened in all the cases. If the traumatic aneurism have assumed a *circumscribed* character, it must be treated on the principles laid down for this form of the disease, the supplying artery being ligatured above the tumor; and cases are not wanting in proof of the success of this practice.

It occasionally, though rarely, happens that a *varicose aneurism* is formed in the groin or upper part of the thigh, as the result of wound of artery and vein in this situation. It usually presents the ordinary characters of this disease, but some peculiarities have occasionally been met with. Thus, in a case related by Mr. Horner, there was a wavy motion in the femoral vein on the uninjured side, arising from the blood in the wounded vessel communicating a thrill upwards to that contained in the vena cava. In a case related by Dr. Morrison, it is stated that a tumor as large as the human uterus at the third month of pregnancy, communicated with the injured vein.

The treatment of this disease is exceedingly unsatisfactory; of 4 cases in which the external iliac artery was tied, a fatal termination occurred in every instance, 2 of the patients dying of gangrene of the limb, and the remaining 2 of secondary hemorrhage and consecutive pneumonia. It has consequently been proposed by Mr. Guthrie that the tumor be laid open, and the artery secured above and below the aperture in it. As this plan has never been fairly put in practice, it would perhaps be useless to speculate on the chances of success likely to attend it; but yet we must bear in mind, that laying open an aneurism of this kind in the groin is a very different matter from adopting the same procedure at the bend of the arm, or in a situation where the surgeon can readily command the artery on the proximal side of the sac. The gush of blood from so large an artery as the common femoral, would be so great, that with whatever rapidity the operation were performed, there would be considerable risk of the patient suffering a fatal hemorrhage, before the vessel, matted and incorporated as it would be, with surrounding parts, could be separated and secured; and the ligature of the vein would probably be followed by gangrene of the limb.

Recent wounds and traumatic aneurisms of a diffused kind, connected with the arteries of the leg and foot, require to be treated by the free exposure of the bleeding orifice in the vessel, and its inclusion between two ligatures. In doing this, if the wound is situated in the posterior tibial or peroneal artery, the surgeon will have to cut freely by the side of or through the muscles of the calf. This he must do in the direction of their fibres, injuring them by transverse incision as little as possible, and by taking the track of the wound as his

guide, the bleeding vessel will at last be reached, and must then be tied in the usual way. In such cases as these, surgeons have often attempted to arrest the hemorrhage by the ligature of the superficial femoral or popliteal arteries; and though they have occasionally been successful, as happened in a case in which I saw the popliteal ligatured for a wound of one of the arteries of the leg, yet I fully concur with Mr. Guthrie in deprecating this practice, as contrary to good surgery, and, with him, regard the success that has occasionally followed these operations as purely accidental.

Small *circumscribed* aneurisms are occasionally met with in the foot, in consequence of the wound of one of the plantar arteries, as in operations for club-foot. If pressure have failed in preventing or curing the disease, the only course left to the surgeon is to lay the tumor open, and to ligature the artery on either side in the usual way.

CHAPTER XIII.

INJURIES OF MUSCLES AND TENDONS.

Sprains, or *strains*, of muscular parts without rupture of fibre, are of very common occurrence, especially about the shoulder, hip, and loins, and are accompanied by much pain, stiffness, and inability to move the part. When occurring in rheumatic subjects, these injuries not uncommonly give rise to severe and persistent symptoms. In some cases painful atrophy, rigidity, or local paralysis of the injured muscle being induced.

In the treatment of these accidents, when recent, it will be found that kneading or rubbing the part with a stimulating embrocation, the application of dry cupping, or, if the pain be severe, the abstraction of a few ounces of blood by cupping, together with rest, is most efficient. If the injury occur in a rheumatic constitution it will be found useful to give colchicum and Dover's powder in the following form: ℞ Extr. Colchici Acetici, gr. i. Pulv. Ipecac. comp., gr. x. Extr. Coloc. comp. gr. iv., f. pil. iij. If the pain continue, the application of the "thermic hammer" is exceedingly serviceable, and if local paralysis or atrophy ensue, the use of the electro-magnetic apparatus will be beneficial.

The subcutaneous rupture of muscles and tendons not unfrequently occurs, not so much from any external violence, as by the contraction of the muscle rupturing its own substance. In the majority of cases, when rupture takes place, it is the tendon that gives way, most commonly at its point of attachment to the muscle, which opposes itself, by its vital contractility, to that forcible extension which must necessarily precede its rupture. Sedillot found that in 21 cases, the rupture occurred at the point of origin of the tendon 13 times; and in the remaining 8, the muscle itself was torn. It occasionally happens that the muscular sheath is ruptured, so that the belly of the muscle forms a kind of hernial protrusion through the aperture; or the tendon may be displaced by rupture of its sheath. This usually happens with the long head of the biceps, or the extensor tendons of the fingers.

These ruptures most commonly occur in middle-aged people, who have lost the elasticity of youth, though their physical strength be unimpaired. At the moment of the rupture taking place, the patient usually experiences a sudden shock, as if he had received a blow, and sometimes hears a snap. He becomes unable to use the injured limb, and at the part where the rupture has occurred

finds a hollow or pit, produced by the retraction of the end of the torn muscle, which is contracted into a hard lump above this.

These accidents, though troublesome, are seldom serious. The tendo-achillis, the quadriceps-extensor of the thigh, the triceps of the arm, the biceps, the deltoid, the rectus abdominis, are the tendons and muscles that most commonly give way, with the relative frequency of the order in which they are placed.

The mode of union of these injuries has been well described by Paget. When a tendon is cut or torn across, an ill-defined mass of nucleated blastema of a greyish-pink tint is effused into the cellular tissue and sheath, between the cut ends. About the 4th or 5th day, this has become more defined, forming a distinct cord-like uniting mass between the ends of the tendon; in the course of two or three more days, this mass has become tough and filamentous; the tissue gradually perfecting itself, until it closely resembles tendinous structure, though for some time it remains dull white and more cicatrical in appearance. The strength of this bond of union is marvellously great; Paget found that the tendo-achillis of a rabbit, six days after its division, required a weight of 20 lbs. to rupture it. In ten days the breaking weight was 56 lbs. Divided muscles unite in the same way as tendons, but less quickly, and by a fibrous bond.

Treatment.—The principle of treatment in these cases is extremely simple: it consists in relaxing the muscles by position, so as to approximate the divided ends; and maintaining the limb for a sufficient length of time in this position for proper union to take place. If relaxation be not attended to, the uniting bond will be elongated and weak. Stiffness and weakness are often left for a length of time—for many months, indeed—after union has taken place. Warm sea-water douches, followed by methodical friction, will greatly tend to restore the suppleness of the parts.

When the tendo-achillis is ruptured, the best apparatus consists of a dog-collar placed round the thigh above the knee, from which a cord is attached to a loop in the back of a slipper; by shortening this cord, the leg is bent on the thigh, and the foot extended, so that the muscles of the calf become completely relaxed. After this simple apparatus has been used for two or three weeks, the patient may be allowed to go about wearing a high-heeled shoe for some weeks longer.

When partial rupture of one of the extensor muscles of the thigh takes place, the patient's limb must be kept for some little time in the same position as for fractured patella, and then he may be allowed to walk about with a leather splint behind the knee, so as to present flexion of this joint. In muscular or tendinous ruptures of the arm, a sling is all the apparatus required, but it is especially in these injuries of the deltoid that paralysis and atrophy are apt to result.

CHAPTER XIV.

INJURIES TO BONES.

A BONE may be bruised, bent, or fractured. *Bruising of the bone* and periosteum often occurs, and is usually of no great moment, but if severe, or happening in bad constitutions, or in old people, it may give rise to serious consequences.

If the contusion be severe, the vitality of a layer, or even of the whole substance of the bone, may be destroyed, as happens sometimes from the graze or

contusion of a bullet. Even a moderate contusion of a bone that is but thinly covered, as the shin, or elbow, may give rise to troublesome symptoms from inflammation of the periosteum. In old people, the contusion of a bone is frequently followed by its atrophy and shortening, as happens in the neck of the femur; and in strumous constitutions, serious disease of the bone may be attributed to this cause.

In the treatment of bruised bone, leeches and fomentations are the most important means that we possess; the after-consequences will be considered when we come to speak of necrosis.

Bending of bone may occur in two conditions, with or without fracture: independent of fracture, it is most commonly met with in very young subjects, before the completion of ossification, the bone being healthy, but naturally soft at this period of life. It occasionally takes place after the adult age, but is then the result of some structural change, by which the natural firmness of the osseous tissue is diminished. The bending most commonly occurs in the long bones, especially the clavicle, the radius, and the femur, but sometimes is met with in the flat bones, or those of the skull, in which depression takes place from a blow without fracture having occurred. In many cases of bending both of long and flat bones, there is partial fracture on the convex side.

The treatment is simple: the surgeon gradually straightens the bone, by applying a splint on its concave side, towards which the bone is pressed by a bandage and a pad, applied upon its greatest convexity.

FRACTURES.

The management of fractures constitutes one of the commonest duties of the surgeon, and hence the consideration of all that relates to their nature and treatment is of the very utmost importance.

Fractures are almost invariably the result of external violence. This may act in two ways: directly or indirectly.

The worst forms of fracture are occasioned by direct external violence, the blow crushing and splintering the bone, as by the passage of a heavy wheel, or a gun-shot injury. When the bone is broken by direct violence, the fracture is always at the seat of injury, and is often complicated with considerable mischief to the soft parts, the result of the same force that breaks the bone. Indirect violence may break a bone in two ways. One that is more commonly talked of than seen is by "contre-coup," in which, when a blow is inflicted on one part, the shock that is communicated expends its violence on the opposite point, where the fracture consequently occurs. This form of injury is chiefly met with in the head; and although its occurrence has been denied, I cannot doubt it, as I have seen unequivocal instances of this kind of fracture.

In the next form of indirect violence occasioning fracture, the bone is broken by being snapped, as it were, between a resisting medium on one side, and the weight of the body on the other. Thus, a person jumping from a height, and alighting on his feet, may break his legs by their being compressed between the weight of the body above and the ground below. The long bones are those that are most frequently fractured in this way, and the fracture occurs at the greatest convexity, or at their weakest point. When a person jumps from a carriage that is in motion, although the height of the fall be not great, yet its force is considerable, the body coming to the ground with the same velocity as that with which it was being carried onwards in the vehicle. Hence, fractures received in this way are usually severe, and often compound or comminuted.

Muscular action is not an unfrequent cause of fracture of those bones into which powerful muscles are inserted. This is especially the case with the patella and some of the bony prominences, such as the acromion, which are broken in the same way that a tendon is ruptured,— by the violent contraction

of the muscles attached to them tearing them asunder. It is not often that the long bones are so fractured, but it has happened that the humerus has been broken by a person striking at, but not hitting another; or that the clavicle has been fractured by a rider giving his horse a back-handed blow. In these cases, however, muscular action may not have been the sole cause, the weight of the limb also tending to fracture the bone. Those bones that do not offer attachment to any powerful muscles, as the cranial, for instance, cannot be fractured in this way.

The *predisposing causes* of fracture are numerous and varied.

Some bones are especially liable to be broken in consequence of their serving as points of support. Thus, when a person falls upon the hand, the shock is transmitted from the wrist-joint through the radius, humerus, and clavicle, to the trunk; the radius and clavicle being the weaker bones, are especially liable to be fractured under these circumstances. So again, the situation of a bone irrespective of use, or any other circumstance, may predispose it to fracture; the prominent position of the nasal bones, and the exposed situation of the acromion, render these parts peculiarly liable to this injury. The shape of some bones disposes them to fracture; thus, a long bone is necessarily more readily broken than a short and thick one; hence, fracture of the tibia and femur from falls on the feet are more common than of the os calcis. Certain parts of bone are more commonly fractured than others. Those points especially into which powerful muscles are inserted, or that are in exposed situations, and hence liable to injury, or to receive the weight of the falling body, are often broken. Hence, the acromion, the olecranon, and the neck of the femur, are commonly fractured

Age exercises considerable influence, not only on the general occurrence of fracture, but on the peculiar liability of certain bones. Though fractures may occur at all ages, even in intra-uterine life (Chaussier having dissected a fœtus that had 113 fractures), yet, bone being elastic and cartilaginous in early age, is less readily broken than when it has become brittle and earthy, as in advanced life. In children, fractures most commonly occur in the shafts of the long bones; or, at the point of junction between the shaft and epiphysis, where ossification has not as yet taken place. This separation of the epiphysis in children, the detachment as it were of the terminal points of ossification, is not unfrequently met with, and occurs chiefly at the lower end of the humerus and femur, sometimes in the radius and other bones. As age advances, the compact tissue of the shaft becomes denser and harder, but the cancellous structure of the extremities more dilated, and looser, hence fracture of the neck of the femur is especially common in old people. In young persons also, the bone is usually simply broken transversely, but fractures taking place at a more advanced period of life generally assume an oblique direction, and become comminuted; so also they more commonly extend into joints than when occurring in early age. Occasionally fracture termed "*spontaneous*," happens without any very direct occasioning cause, or under the influence of a degree of violence that would usually be insufficient to occasion it. This may happen in consequence of the texture of the bone being weakened or rendered more brittle by disease, such as mollities or fragilitas ossium, by the cancerous cachexy, by syphilis, by the presence of cancerous growths within the substance of the bone itself, or by the pressure upon, and absorption of it, by some neighboring tumor. In other cases, again, it occurs without any apparent disease, local or constitutional. This usually happens as the result of the brittleness and weakening induced by age. I have known a gentleman little above fifty, apparently in perfect health, break his thigh with a loud snap whilst turning in bed. In these cases union rarely takes place, or not without much difficulty.

Sex necessarily influences the liability to fracture, men being more frequently exposed to the causes of this injury than women. In women the bones that

are most frequently fractured are the clavicle, the tibia, and the neck of the femur. In men, the shafts of the long bones, the cranium, and pelvis, are most frequently broken.

From statistical accounts it would appear that the right limbs are more frequently broken than the left, being more exposed to the causes of fracture. It has been supposed that the bones are more brittle in winter, and hence break more readily than at other seasons, but this is altogether a mistake, though fractures may be common at this period of the year, from falls being more frequent.

Fractures present important varieties as to their *nature* and their *direction*. The varieties as to nature depend upon the cause of the fracture, its seat, and the age of the patient.

Varieties as to Nature.—Fractures are divided into two great classes, according as they are accompanied or not by an open wound. When the bone is merely broken across, the fracture is a *simple* one. When one fragment is wedged into another, the compact tissue being driven into the cancellous structure, it is said to be *impacted*. When the bone is broken into several fragments, it is *comminuted*.

When the soft parts covering the broken ends of bones are torn through, so that the fracture communicates by a wound with the surface of the body, it is said to be *compound*. The fracture may be rendered compound in two ways, either by the same injury that breaks the bone lacerating the soft parts, as when a bullet traverses a limb, and fractures the bone; or else by the protrusion of one of the extremities of the broken fragment through the integuments covering it; this necessarily most frequently happens when the fragments are sharp and pointed, and the coverings thin, and may be occasioned either by muscular contraction driving the fragment through the skin, or by some incautious movement on the part of the patient, forcing it through.

A fracture is said to be *complicated* when the injury to the bone is conjoined with other circumstances which are perhaps of more importance than the mere fracture itself, the complication constituting perhaps the most serious part of the injury, and influencing greatly the general result of the case. Thus, a fracture may be complicated with injury of an important internal organ, as, of the brain, lungs, or bladder; the injury to the organ being inflicted by the projection against it of one of the broken fragments. So also a fracture is not unfrequently complicated with the wound of one of the principal arteries of the part, as happens especially in the leg, where the tibial arteries, being in close contact with it, are often torn by the broken bone. In other cases, again, the fracture is associated with injury of a joint, or dislocation of it. Besides these varieties of fracture, it occasionally happens that a bone is only cracked, or partially broken. This especially occurs in the bending of bone in children, in which cases the fracture may be *partial* or *incomplete*, merely extending across the convexity of the curve made by the bone. *Intraperiosteal* fractures have been described, but this is an anatomical refinement of little practical value.

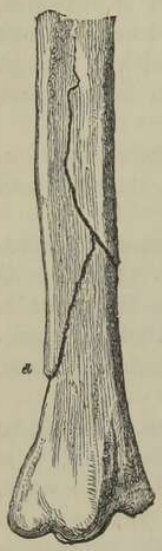
The *direction* assumed by fractures varies greatly, and depends materially on the cause of the injury, as well as upon the bone that is fractured.

The line of fracture may run through a bone in three different directions: either transversely, obliquely, or longitudinally to its axis. The *transverse* fracture is the simplest, and is seldom complicated with injury to the neighboring parts. It chiefly occurs in children, and very frequently in the articular extremities or processes of bones; it unites readily, and is attended by but little displacement; it is most commonly the result of direct violence, but it may arise from muscular action, as in the case of the patella, which is usually broken in this way.

The *oblique* fracture commonly occurs from indirect violence; the breaking

force being applied to the ends, and not across the shaft. It often runs a long way, more than half the distance of the shaft of a bone, and is more dangerous than the transverse, owing to the obliquity of the fracture causing the ends of the bone to be sharply pointed (Fig. 78, *a*), and thus frequently to puncture the skin, or to perforate an artery. It is tedious in its cure, owing to the fragments being less directly in apposition; hence, also, there is a greater liability to shortening of the limb; it is principally met with in the shaft of the long bones of adults, and elderly people.

Fig. 78.



The *longitudinal* fracture consists of a splitting of a bone in the direction of its axis (fig. 78, *b*), and has a great tendency to run into a joint, and to separate the articular ends of the bone. It most commonly results from gun-shot injury, especially from Minié balls, but I have seen cases of its occurrence from very slight violence. The great danger of longitudinal fractures is the implication of the neighboring articulation, but in some cases it extends a little distance up the shaft of a bone, stopping short of this.

The *signs* of fracture, taken individually and singly, are all more or less equivocal, and may arise from other conditions of the part, being common to various injuries. It is rather by their simultaneous occurrence that we consider them as pathognomonic of the existence of a broken bone.

Amongst the more equivocal signs may be mentioned the occurrence of pain in the limb, which may be owing either to the laceration of the soft parts by the broken fragments, or to the general injury inflicted upon it. So also the existence of increased or diminished swelling is observed in different cases of fracture; the augmented swelling being owing either to the extravasation of blood into the limb, which often takes place to a very considerable extent, even without the wound of any principal vessel; or, to the approximation of the attachments of the muscles, by the shortening of the part. Diminished swelling, or flattening, occurs in some cases, in consequence of the weight of the limb drawing the part down, and thus lessening natural rotundity.

The more special and peculiar signs of fracture are three in number: 1st, *A change in the shape of the limb;* 2d, *Mobility in its continuity;* and 3d, *The existence of grating between the broken ends of bone.*

1st. The *change in the shape* of the limb, due to the displacement of portions of the broken bone, is perhaps the most important sign of fracture; it manifests itself by a want of correspondence between the osseous points on opposite sides of the body, by an increase or diminution of the natural curves of the limb, by angularity, shortening, or swelling.

In investigating the existence and extent of displacement in a case of fracture, the surgeon should always strip his patient, compare the points of bone on the opposite sides of the body, and their relative situation to some fixed and easily distinguishable neighboring prominence on the trunk or injured part of the limb. From this the measurements may be taken, by grasping the injured part and the corresponding portion of the healthy limb in either hand, and running the fingers lightly over the depressions and elevations, marking any difference that exists; or, if greater accuracy be required, measuring by means of a tape. In some cases the measurement must not be made between the trunk and the limb injured, or even from one extremity of the limb to the other, as shortening of the whole member might depend on other causes than fracture, such as wasting, diseases of joints, or dislocation, but the measurement must be taken between different points of the bone actually injured.

The *displacement* of a broken bone may be the direct result of the violence which occasions the fracture, the fragments being driven out of their position,

as when a portion of the skull is beaten in; or it may result from the weight of the limb dragging downwards the lower fragment, as in a case of fractured acromion. In some cases, it is either occasioned, or greatly increased, by the direction of the fracture. Thus, in several cases of broken tibia which have been under my care, the line of fracture being oblique from above downwards, and from before backwards, I found the upper end of the lower fragment project considerably forwards, sliding, as it were, along an inclined plane in the upper one, and in one of these cases that I had an opportunity of dissecting after amputation, the direction of the fracture, rather than muscular action, appeared to be the cause of displacement. In transverse fractures there is always but slight displacement.

Muscular contraction is, however, without doubt, the most frequent cause of displacement; hence, it has been found that in paralyzed limbs that are fractured, there is but little deformity. The contraction of the muscles of the part approximating their points of attachment, owing to the support or resistance offered by the bone being removed, draws the most movable fragment out of its normal position. The other causes that have just been mentioned, tend greatly to favor this kind of displacement; but in some cases, as in fractured patella, the displacement is entirely muscular, and in all fractures of the long bones it is chiefly due to muscular contraction.

The *direction* of the displacement is principally influenced by the direction of the fracture, the position of the limb, and muscular action; it may be angular, transverse, longitudinal, and rotatory.

In the *angular* displacement there is an increase of the natural curvature of the limb; the concavity of the angle being on the side of the most powerful muscles; thus, for example, in fracture of the thigh, the angle projects on the anterior and outer side of the limb, because the strongest muscles being situated behind and to the inner side, tend, by their contraction, to approximate the fragments on that aspect. This displacement principally occurs in oblique and comminuted fractures.

The *transverse* or *lateral* displacement occurs when a bone is broken directly across, the fragments often hitching one against another, and so being, as it were, entangled together. In this case there is often but very little deformity.

In the *longitudinal* displacement there may be either shortening or elongation of the limb. When there is shortening, as most commonly happens in oblique fractures, it is dependent on muscular contraction, the broken ends of bone being drawn together so as to overlap one another, or "riding." In other cases, the shortening may be owing to the impaction of one fragment in the other. In some cases there is preternatural separation of the fragments, the weight of the limb tending to drag the lower one downwards, or muscular contraction drawing the upper one away from it.

The *rotatory* displacement is owing to the contraction of particular sets of muscles twisting the lower fragment on its axis, as well as producing shortening of the limb. Thus, the external rotators in fractures of the neck of the thigh bone, and the supinators in some fractures of the radius, have a tendency to twist or rotate the lower fragment in an outward direction.

2d. The occurrence of *preternatural mobility* in the continuity of a bone cannot exist without fracture, and separation of the fragments from one another; hence, its presence may always be looked upon as an unequivocal sign of the bone being broken. It occasionally happens, however, that fracture may take place, and, owing to the impaction or wedging together of the fragments, mobility not be perceived; hence, its absence cannot in all cases be construed into a proof of the non-existence of fracture.

3d. Another sign of much value in practice is the occurrence of *crepitus*, or rather of the *grating* together of the rough surfaces of the broken bone, which

can be felt as well as heard on moving the limb. This grating can only occur when the fragments are movable and in contact, and is especially perceptible when the rough ends of the broken bone are directly rubbed against one another, and not the smooth periosteal surfaces merely opposed, or overlapping. It is not, however, an invariable accompaniment of fracture, being absent in some cases, in which the fracture is firmly impacted, or when the fragments are widely separated. It must not be confounded with crepitation that occurs in the limbs from other causes, as from emphysema, or the effusion of serous fluid into the sheaths of the tendons, which gives rise to a peculiar crackling sensation, very different from the rough grating of a fracture.

It will thus be seen that each of these symptoms, taken individually, is more or less equivocal, and that it usually requires a combination of at least two of them to determine whether fracture exists. In ascertaining the existence of a fracture, the surgeon should make the necessary manipulations with the utmost gentleness, but yet effectually, so that no uncertainty may be allowed to remain as to the seat and nature of the injury, more especially when it occurs in the vicinity of a joint. The increased mobility may be ascertained by fixing the upper fragment, and rotating the lower portion of the limb; the grating, by drawing down the lower fragment, so as to get the rough surfaces in apposition, and then grasping the limb at the seat of fracture with one hand, rotating it gently with the other. The displacement must be ascertained by measuring the limb carefully in the way that has been directed, and by comparing the injured with the sound side.

A fractured bone is ultimately *united* by being soldered together by the deposition of new bone around, within, and lastly between, the broken fragments. In exceptional cases, as in fractures occurring within the capsule of a joint, and in those of the patella and the olecranon, union is effected by fibrous or filamentous tissue. In some instances that will hereafter be considered, owing to peculiar, local, or constitutional circumstances, new bone is not formed, but the uniting medium is of a fibrous character.

The new bone that constitutes the bond of union is termed *callus*. In many cases, a larger quantity of this is temporarily deposited than is permanently left. This temporary formation of bone goes by the name of the "provisional callus." It is formed partly external to the fracture, incasing the broken ends, and partly in the medullary canal, so as to include the fragments between layers of new bone, and thus maintain them in contact. That which is permanently left, and which intervenes between the broken ends, is called the "definitive callus."

The production of callus has been studied with much care by Haller, Duhamel, Bordenave and Hunter, by Dupuytren, Breschet and Villerme, and more recently by Stanley and Paget. From the observations of these pathologists, it would appear, that the union of a broken bone takes place through the medium of plastic matter, deposited by a process of adhesive inflammation set up in the injured bone itself, its periosteum, and the neighboring soft parts; the lymph thus formed gradually undergoing development into osseous tissue. The whole process, indeed, is strictly analogous to that which takes place in the ordinary healing of a wound by adhesion, and the development of the cicatrical tissue. The broken fragments are at first movable, and surrounded by a considerable extravasation of blood. In the course of ten or fourteen days this has ordinarily undergone absorption to a considerable extent; the periosteum and the medullary membrane in the vicinity of the fracture, the tissues around it and the broken bone itself, become very vascular, and pour out a quantity of lymph between and around the fragments, as well as within the medullary canal, so that the fractured ends are ensheathed by a reddish gelatinous mass of a fusiform shape, thickest opposite the seat of injury. This gradually becomes more and more consolidated, and in proportion as it becomes firmer, the mobility of the fragments lessens, and the ends of the bone becoming smooth by the plastic

deposit being adherent to, and interposed between them, grating is less distinct. From the third to the fourth week the lymph has assumed a sufficient degree of firmness to keep the fragments in apposition, though the bone still yields readily at the seat of fracture. This lymph, which is poured out not only by the periosteum and bone, but by all the soft parts in the neighborhood of the fracture, gradually undergoes ossification, the bony matter being first deposited in a granular manner, but in sufficient quantity by the sixth or eighth week to unite the fracture pretty firmly. The callus, which is at first soft and spongy, and differs from old bone in its microscopic as well as ordinary physical characters, gradually assimilates to old bone, both in hardness and in structure; osseous corpuscles and vascular laminated canals forming in it; and it becomes smooth on the surface, being invested by a dense cellulo-fibrous periosteum, until, by the end of six or eight months, ossification is perfect. The last process in the consolidation of the fracture is the formation of new bone between the broken ends. This does not take place definitely until a considerable period after the ensheathing callus has been formed. This bone is deposited in the plastic matter effused between the fragments, which undergoes ossification in the same way as the external callus does. By the time that this intermediate or definitive callus is fully formed, that portion of the ensheathing or provisional callus which is not required for the preservation of the permanent integrity of the bone, has been gradually removed, or has moulded itself closely to the shape and condition in which it will ultimately remain, the medullary canal having again become free, and the ends of the fracture rounded off. In some cases the medullary cavity is not restored to its former condition for a considerable time, continuing to be partially occluded by a thin septum of callus.

According to Paget, the plastic matter that is effused around and between the bones undergoes ossification in various ways. Those fractures that ossify quickly do so most commonly through nucleated blastema, a fine closely-granular ossific deposit taking place in the blastema, and becoming converted into the laminæ of the cancellous tissue, the nuclei becoming probably converted into bone corpuscles. In other cases again, the nucleated cells of granulations and plastic effusions ossify by being transformed into bone. Then, again, the new bone may be formed by the plastic exudation passing, first of all, through the stages of fibrous tissue, of cartilage of the purest fœtal form, or through fibro-cartilage.

In those fractures that are transverse, and that remain in steady apposition during ossification, and more especially if they are but thinly covered by soft parts, the union appears to take place directly and immediately between the opposed osseous surfaces; there being no appearance of those accessory deposits of bone that usually go by the name of "provisional callus." If, however, the fracture occurs in a bone that is thickly invested by soft parts, masses of new bone will be thrown out around the fragments, evidently the result of deposition from the surrounding inflamed tissues, rather than from the injured periosteum or bone. The influence of neighboring soft parts in determining the deposits of new bone is well marked in the tibia. In a fracture of this bone we find, that at the anterior and inner part, which is thinly covered, union takes place directly between the broken ends; but at the posterior and outer side, where there is a thick envelopment of tissue, a large mass of provisional callus will often be found filling up even the interosseous space. That neighboring parts participate in the inflammation set up around the fracture, and throw out callus, is evident by what takes place occasionally when one of the bones of the fore-arm or leg is broken. Periostitis is then set up in the unbroken bone, opposite the seat of fracture, and osseous matter sometimes deposited by it. We have specimens illustrating this point in the University College Museum.

If the fracture be not well reduced, the ends not being in proper apposition, or if it is comminuted, it will commonly be found that masses of new bone are

deposited as buttresses or supports; or, enveloping the splinters, consolidate them in this way with the rest of the shaft. So, also, if the fractured bones are not kept sufficiently quiet during treatment, the neighboring parts become irritated, and provisional callus is formed. Hence, as Paget has remarked, we commonly find this deposit in fractures of the ribs, which are kept in constant motion by the respiratory actions. In impacted fractures there is, from the perfect apposition of the surfaces, but little callus formed.

From all this, I think it clear that in simple fractures the provisional callus is deposited principally by the surrounding soft tissues, and also, to a certain extent, by the periosteum and medullary canal, its quantity being dependent on the amount of irritation set up in these textures. The definitive callus, on the other hand, is directly and immediately formed by the vessels of the fractured bone itself, and the comparative want of vascular supply to this tissue may account for the slowness of its formation.

In compound fractures, union takes place by the ends of the bone, which lie bathed in the pus of the wound, granulating and throwing out plastic matter, which becomes directly converted into bone. There is in many cases but little provisional callus; but in most instances a large quantity of accessory osseous deposit takes place, more particularly if the displacement be considerable. The union of these fractures precisely resembles that of a wound in the soft structures — by granulation — the process occupying a much longer time than that which is necessary for the union of simple fractures, consolidation not being effected for three or four months. Rokitansky is of opinion that superficial exfoliation of that layer of bone which is bathed by the pus, takes place, and that it is after this has separated that the granulations spring up, in which the new bone is deposited. I think it admits of very considerable doubt whether this process of necrosis goes on in all cases of compound fracture.

Union of fractures, like all other vital actions, takes place more readily and much more quickly in the early periods of life than at a more advanced age, and is always more speedily accomplished in the upper than in the lower extremities.

TREATMENT OF SIMPLE FRACTURES.

In conducting the treatment of a fracture, the object of the surgeon should be not only to obtain a sound and strong limb, but one that presents as little deformity and trace of former injury as possible. In order to accomplish this, the broken ends of the bone must be brought into as perfect apposition as possible, the recurrence of displacement must be prevented, and the local and constitutional condition of the patient properly attended to.

When the surgeon is called to a person who has met with a fracture, if it be a severe one of the upper extremity, or of any kind of the lower limbs, he must see that the bed, on which the patient may have to remain for some weeks, is properly prepared, by being made hard, flat, and firm, and, if possible, covered with a horse-hair mattress. The surgeon must then superintend the removal of the patient's clothes, having them ripped up the seams, so that they may be taken off with as little disturbance to the injured part as possible. He next proceeds to the examination of the broken limb, using every possible gentleness consistent with acquiring a proper knowledge of the fracture. After satisfying himself upon this point, the limb should be laid upon a soft pillow, until any necessary apparatus that may be required has been prepared.

When all has been got ready, the reduction of the fracture, or the bringing the fragments into proper apposition, must be proceeded with. This should, if possible, always be done at once, not only lest any displacement that exists may continue permanently,—the muscles, after a few days, becoming shortened, rigid, and unyielding, not allowing reduction to be effected without the employment of much force, — but also with the view of preventing irritation and

mischief to the limb, by the projection of the sharp and jagged ends of bone into the soft structures. By early reduction we may sometimes prevent a sharp fragment perforating the skin, thus rendering a simple fracture compound, or lacerating muscles and nerves, inducing perhaps traumatic delirium, and certainly undue local inflammatory and spasmodic action.

The great cause of displacement in fractures has already been stated to be muscular contraction; hence, in effecting reduction of a fracture and in removing the displacement, our principal obstacle is the action of the muscles of the part. This must, and always may be, counteracted, by properly relaxing them by position; so soon as this is done, the bony fragments will naturally fall into place; but no amount of extension and of counter-extension can get these into position, and much less retain them there, unless all muscular influence be removed.

In ordinary fractures no force is necessary for this, or should ever be employed in accomplishing it; but attention to the attachment of the muscles of the limb and proper relaxation of them is all that is required. In impacted fractures it is occasionally necessary to use force in order to disentangle the fragments, but this is the only form of fracture in which its employment is justifiable. In effecting the reduction, not only must the length of the limb be restored, but its natural curves must not be obliterated by making it too straight.

After the reduction has been accomplished, means must be taken to prevent the return of the displacement; for if the parts be left to themselves, muscular action, or the involuntary movement of the patient, would be certain to bring about a return of the faulty position. In many cases it is exceedingly difficult to preserve the fracture undisplaced for the first few days after its occurrence, in consequence of spasmodic movement of muscles of the limb, or of restlessness on the part of the patient. About this, however, the surgeon need not be anxious, as no union takes place for the first week or ten days; at the expiration of that time, the muscles will have probably lost their irritability, and the patient have got accustomed to his position, so that with a little patience, or by varying the apparatus and the position of the limb, good apposition may be maintained.

The return of displacement is prevented, and the proper shape and length of the limb are maintained, by means of bandages, splints, and special apparatus of various kinds. In applying these, care should be taken not to exert any undue pressure on the limb. Pads and compresses of all kinds should, if possible, be avoided; they do no good that cannot be effected by proper position, and often occasion serious mischief by inducing sloughing of the integuments, over which they are applied. Screw apparatus has been invented with the view of forcing fragments into proper position, but nothing can be more unsurgical and unscientific than such barbarous contrivances as these.

In cases in which there is much tendency to a return of the displacement, it has been recommended to divide the tendons of some of the stronger muscles inserted into the lower fragment. This, however, can very rarely be necessary, and in those cases in which I have done it, or seen it done, no material benefit has resulted.

The *bandages* used for fractures should be the ordinary grey calico rollers, about three fingers' breadth in width, and of sufficient length. In applying them, especial care must be taken that the turns press evenly upon every part, and that the bandage be not applied too tightly in the first instance. No bandage should ever be applied *under* the splints. In this situation they are not only useless, but highly dangerous, by inducing risk of strangulation. The limb should also be examined from time to time, and if the patient complain of any pain or numbness, or if the extreme part look blue and feel cold, the bandage must be immediately removed; for though it have not been applied tightly, swelling of the limb may come on from various causes, to such an extent as to produce strangulation, and consequent gangrene of it, as I have

seen happen in at least three instances, the limb requiring amputation in both cases (Fig. 83). It is remarkable that the whole of a limb will fall into a state of gangrene under these circumstances, with but little pain, and often with very slight constitutional disturbance, the parts having their sensibility deadened by the gradual congestion and infiltration of the tissues. When such an unfortunate accident happens, immediate amputation must be had recourse to. Before applying the bandage in a case of fracture, and as often as they are taken off, it is a good plan to sponge the limb with warm soap and water, which prevents the itching that otherwise occurs, and is sometimes very troublesome.

The *splints* that are used in cases of fracture are of various kinds. Tin, wood, leather, and gutta-percha, are the materials usually employed. For some kinds of fracture, special and often very complicated apparatus is very generally used; but the surgeon should never confine himself to one material, or one exclusive mode of treating these injuries, as in different cases special advantages may be obtained from different kinds of splints. Wood and tin are principally employed in the lower extremity, where great strength is required to counteract the weight of the limb and the action of its muscles, and care must be taken to pad very thoroughly splints made of these materials. Leather, gutta-percha, and pasteboard are more commonly useful in fractures of the upper extremity, though they may not unfrequently be employed with advantage in the lower limbs. In applying them, a pattern should first be cut out in brown paper, of the proper size and shape; the material must then be softened by being well soaked in hot water, and moulded on to the part whilst soft; so soon as it has taken the proper shape, it should, if leather or gutta-percha is used, be hardened by being plunged into cold vinegar and water; the pasteboard must be allowed to dry of itself. Its edges may then be pared and rounded, and its interior lined with wash-leather or lint. These splints have the advantage of great durability, cleanliness, and lightness The material of which the splint is composed is of less consequence than its mode of application. There are two points that require special attention in this respect:—1st, That the splint is sufficiently broad to extend to the exterior of the limb, and not to press into it; and, 2d, that it embrace securely and fix steadily the two joints connected with the fractured bone; if the thigh, the hip and knee; if the leg, the knee and ankle: from want of attention to this, much deformity often results.

Special apparatus should be employed as little as possible in the treatment of fractures. It is scarcely ever necessary in simple fracture, and is far more cumbersome and costly than the means above indicated, which are all that can be required. I have no hesitation in saying, that a surgeon of ordinary ingenuity and mechanical skill may be fully prepared to treat successfully every fracture to which he can be called, by having at hand a smooth deal plank half an inch in thickness, a sheet of gutta-percha, undressed sole-leather, or pasteboard, to cut into splints as required.

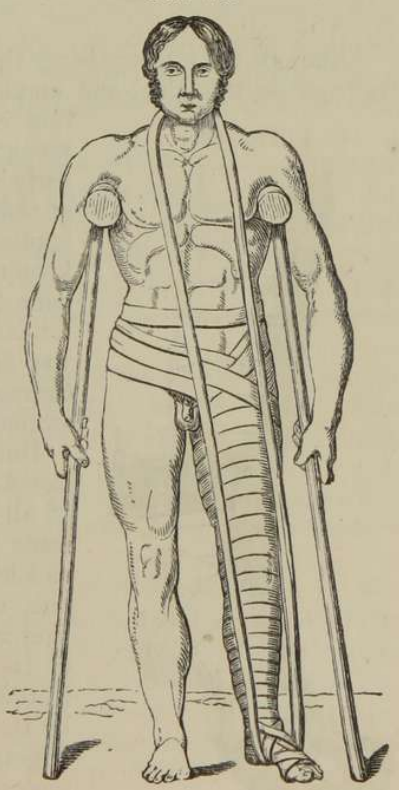
To these simple means *the starch bandage* is an invaluable addition. Although various plans for stiffening and fixing the bandages in cases of fracture, by smearing them with white of eggs, with gum, plaster of Paris, etc. have been employed at various times, it is only of late years that the full value of the starch bandage has been recognized by surgeons, chiefly through the practice and writings of M. Seutin of Brussels.

The advantages of the starch bandage in the treatment of fractures, as well as in many other injuries and diseases, consists in its taking the shape of the limb accurately and readily, and maintaining it by its solidity; in being light, inexpensive, and easily applied, with materials that are always at hand. From its lightness, it possesses the very great and peculiar advantage in fractures of the lower extremity, of allowing the patient to remain up and to move

about upon crutches, during nearly the whole of the treatment, and thus, by rendering confinement to bed unnecessary, preventing the tendency to those injurious consequences that often result from these injuries; and, by enabling the patient to keep up his health and strength by open air exercise, facilitating the consolidation of the fracture. In addition to this, the patient will often be able to carry on his business during treatment. By employing the starch bandage in the way that will be immediately pointed out, I scarcely ever find it necessary to keep patients in bed with simple fractures of the thigh for more than six or seven, or of the leg for more than three or four days, thus saving much of the tediousness and danger of the treatment.

The following is the mode of applying this apparatus that is adopted at the University College Hospital, and which will be found to answer well. The whole limb is enveloped in a layer of cotton wadding, which is thickly laid along and over the osseous prominences; over this should be laid splints of thick and coarse pasteboard, properly shaped to fit the limb, extending beyond and fixing securely the two joints above and below the fracture, and well soaked in thin starch. The pasteboard should be soft, not milled, and be double, and torn down, *not* cut, as in this way the edges are not left sharp. If much strength is not required, as in children, or in some fractures of the upper extremity, a few slips of brown paper, well starched, may be substituted for the pasteboard. A bandage saturated with thick starch must now be firmly applied; and, lastly, this is to be covered by another dry roller, the inner sides of the turns of which may be starched as it is laid on. During the application of this apparatus, extension must be kept up by an assistant, so as to keep the fracture in position; and, until the starch has thoroughly dried, which usually takes from thirty to fifty hours, a temporary wooden splint may be applied to the limb, so as to keep it to its proper length and shape. The drying of the starch may, if necessary, be hastened by the application of hot sand-bags to the apparatus. After the bandages have become quite dry, the temporary splints must be removed, and the patient may then be allowed to move about on crutches, taking care, of course, to keep the injured limb well slung up, and not to bear upon it, or to jar it against the ground (fig. 79). In the course of about three or four days after its application, the apparatus will usually be found to have loosened somewhat, the limb appearing to shrink within it. Under these circumstances it becomes necessary to cut it up with a pair of Seutin's pliers, such as are represented in the annexed wood-cut (fig. 80). This section must be made along the more muscular part of the limb, so that the skin covering the bones be not injured, as represented in fig. 81, and after paring the edges of the splint, it must be reapplied by means of tapes or a roller. It will always be found advantageous to adopt the practice of M. Burggraeve, of Ghent, and to envelop the whole limb in a thick layer of cotton wadding before applying the starched bandage; this, being elastic, accommodates itself to the diminution in the size of the limb, and thus keeps up more equable pressure. Indeed, f

Fig. 79.



late I have invariably adopted this practice, and found much advantage from it, dispensing with any dry roller next the skin which there is always difficulty in applying, and from which there is danger of constriction or of abrasion. In trimming the edges of the splint, it should not be removed from the limb, and, after this has been done, the apparatus must be fixed together again with tapes or a roller. If the fracture be compound, a trap may be cut in the apparatus opposite the seat of injury, through which the wound may be dressed (fig. 82).

Fig. 80.

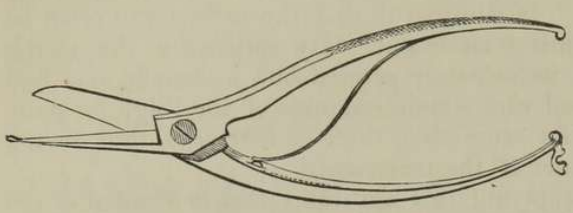
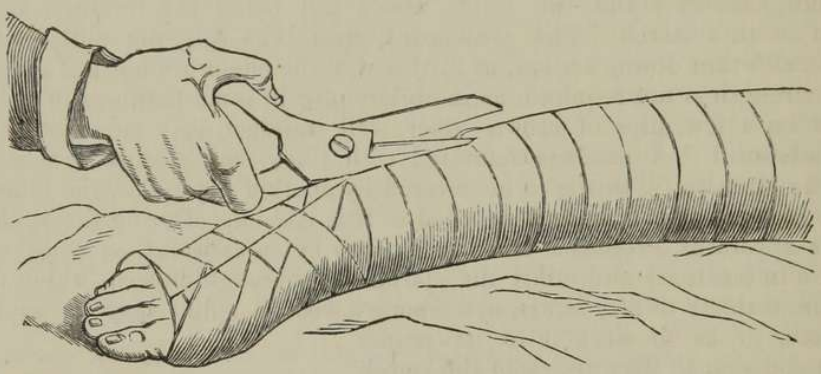
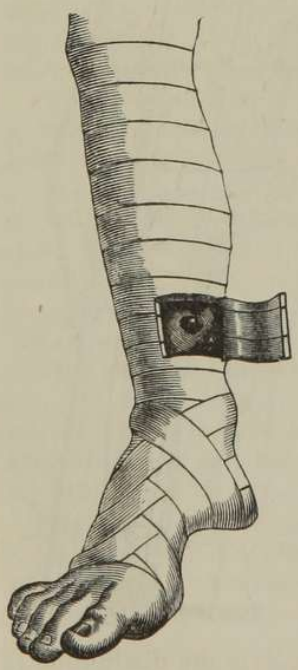


Fig. 81.



Although fully recognising the great advantages to be obtained by treating fractures on this plan, and employing the starch bandage in almost every case that came under my care, I did not think that it was a safe practice to have recourse to it during the early stages of fracture, until, indeed, the swelling of the limb had begun to subside. I therefore never applied it until the sixth, or eighth, or tenth day, keeping the limb properly reduced upon a splint, very lightly bandaged, wet with cold evaporating lotions until this time, fearing that if the bandage was applied at too early a period, the inflammatory turgescence of the limb might give rise to a slow strangulation of it under the bandages.

Fig. 82.



During the last few years, however, I have followed Seutin's plan in some hundreds of fractures of all kinds, putting the limb up in the starch apparatus *immediately* on the occurrence of the injury, and have found the practice an extremely successful one, even in fractures of the thigh; so much so, that at the hospital I now rarely use any other plan of treatment; and, indeed, the more experience of it, the more satisfied am I with the results obtainable by it. I find that the moderate pressure of the bandages, aided probably by the great evaporation that goes on during the drying of so extensive and thick a mass of wet starch, and which produces a distinct sensation of cold in the limb, takes down the extravasation most effectually,

and enables the patient usually to leave his bed about the third day after the injury, when the fracture is in the leg or ankle, and about the sixth when it is the thigh that is broken; so that very commonly we now treat all patients with simple fractures of the leg, and many of those of the thigh, especially in children, as out-patients.[1]

By no other means of treatment have I seen such satisfactory results in cases of fractured thigh, as by the starched apparatus, patients having frequently been cured without any shortening whatever, and with the preservation of the natural curve of the bone.

In compound fractures, also, of the legs and even of the thigh, I have obtained most satisfactory results by this means. In compound fracture of the leg, I have seen the patient walking about on crutches as early as the tenth or fourteenth day, the limb being securely put up in starch; and have more frequently succeeded in getting union of the wound, and consequently in converting the compound into a simple fracture, by putting up the limb in this apparatus, than in any other.

The plaster of Paris bandage may sometimes be advantageously used as a substitute for the starch apparatus. It may be applied in the following way: A roller of coarse soft muslin must have dry plaster of Paris thoroughly rubbed into its meshes, some cold water is then to be poured upon either end of it, so as to moisten it through. A dry roller having been previously applied to the limb, the wetted plaster bandage must be smoothly rolled up it, the surgeon taking care that no reverses are made. In order to avoid these, it may be applied in a spiral or figure of 8 manner over the more unequal parts. Slips of the plaster bandage should also be laid on where additional strength is required, and the whole well wetted from time to time during the application. It hardens in the course of a few minutes, and, as it dries, forms a solid, hard, and light casing to the limb, affording excellent support to the fracture. The plaster bandage possesses the advantage over the starch apparatus of being lighter, and especially of drying and hardening quickly, qualities which render it invaluable in cases in which it is necessary to carry patients any distance soon after the setting of the fracture.

Various Accidents are liable to occur during the treatment of a fracture; some of these are of a general, others of a special, character. Amongst the more general accidents, tetanus, traumatic delirium, and erysipelas, may be mentioned as the most common. Amongst the more special, the occurrence of spasm of the muscles of the limb, abscess, œdema, gangrene, and a tendency to pulmonary and cerebral congestion, are those that have most to be guarded against.

In order to prevent the occurrence of these conditions, the general health must be carefully attended to, the bowels being kept open, the room well ventilated, nourishing diet allowed, and long confinement to bed avoided by the use of the starch bandage.

The treatment of the more general accidents presents nothing that need detain us here; but those that are more special and peculiar to fractures, require consideration.

Spasm of the muscles of the limb, owing to the irritation produced by the fragments, is best remedied by reduction, and the maintenance of the fracture in proper position, by moderate pressure with a bandage. If the spasm be dependent upon nervous causes, full doses of opium will not unfrequently afford relief. In some cases, it is of a permanent character, producing considerable displacement of the fragments. Under these circumstances, the division of the tendons has been recommended, but this practice appears to be

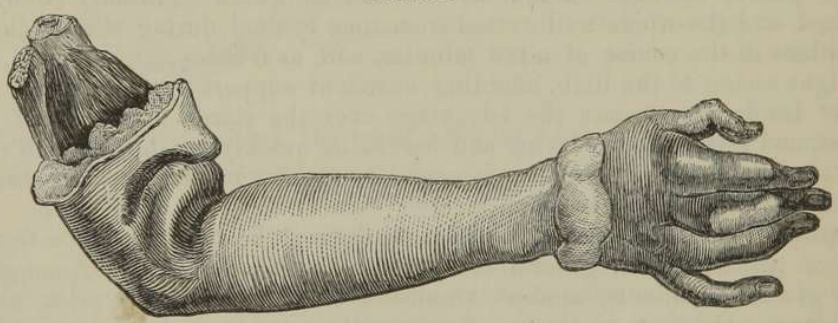
[1] For details of this mode of treatment, I would refer the reader to Mr. Gamgee's very practical work on the starched apparatus.

an unnecessarily severe one, and may certainly most commonly be avoided by attention to the other plans of treatment which have been suggested.

Considerable extravasation of blood is frequently met with in cases of simple fracture, causing great swelling and tension of the limb. By the continuous application of cold evaporating lotions, these collections are usually readily absorbed, and the surgeon should never be tempted by any feeling of fluid or of fluctuation to open them, as he would thereby infallibly convert the simple into a compound fracture, and give rise to extensive ill-conditioned suppuration. In some of these cases of extensive extravasation, the limb appears to relieve itself of the serous portion of the blood effused, by the formation of large bullæ or blebs, which burst or subside, without any material inconvenience. This extravasation very rarely, indeed, runs into abscess; if it do, it must of course be opened, and treated upon ordinary principles. It may lead to gangrene if deeply effused, by the constriction and compression it exercises on the muscles of the limb.

Œdema and gangrene of the limb, may occur as the result of tight bandaging, or else by the swelling of the limb consequent upon extravasation of blood, or inflammatory infiltration causing strangulation of it within a bandage that has been but lightly applied. The occurrence of such accidents should make the surgeon cautious in applying a bandage with any degree of tightness in the early stages of fracture, or, in those cases in which there is already much swelling; and the apparatus should at once be removed whenever the patient complain, even of slight uneasiness; or, indeed, if any appearance of con-

Fig. 83.



gestion, such as blueness, coldness, or vesications of the fingers and toes show themselves. If left on beyond this, gangrene will probably set in, slow strangulation going on under the bandages without much, if any, pain. An excellent plan of judging of the activity of the circulation in a fractured limb after it has been put up, is to leave the ends of the fingers or toes uncovered by the bandage, when by pressing upon one of the nails, the freedom of the circulation may be ascertained, by noticing the rapidity with which the blood returns under it.

In fractures occurring in old people, there is a great tendency to pulmonary and cerebral congestion, partly from determination of the blood, and partly as a consequence of the long confinement required; these fractures commonly proving fatal in this way. The use of the starch bandage, by enabling the patient to get about, is the most effectual prevention to these accidents.

Fractures may be *complicated* with various important local conditions. Thus the extravasation of blood into the limb may arise from a wound of some large vessel, and this may go on to so great an extent as to occasion strangulation of the tissues; if not checked by position and cold applications, it may give rise to gangrene, and lead to amputation. In other cases, again, the soft parts in the vicinity of the fracture may be contused to such a degree that they rapidly run into slough, thus rendering it compound; or a wound may exist, not com-

municating with the broken bone, but requiring much modification of treatment, and special adaptation of apparatus.

The most serious complication of simple fractures, consists in their implicating a joint. The fracture may extend into a neighboring articulation, and thus give rise to considerable inflammatory action, though in some cases no inconvenience results, even though the capsule be perforated by a sharp fragment; but in strumous subjects it may lead to ultimate disorganization of the articulation, requiring excision, which I have several times had occasion to perform in these cases.

The complication of *dislocation* with fracture often occasions great difficulty to the surgeon, as it becomes necessary to reduce the dislocated joint before the fracture is consolidated. In several cases of this description which have fallen under my care, I have succeeded in reducing the dislocation at once, by putting up the limb very tightly in wooden splints, so as to give a degree of solidity to it, and to permit the lever-like movement of the shaft of the bone being employed; and then, putting the patient under chloroform, have replaced the bone without much difficulty. Should the surgeon have neglected to reduce the dislocation in the first instance, it will be necessary for him to wait until the fracture has become firmly united, and then, putting up the limb in splints or in starch, to try to effect the reduction, which, however, will then be attended by very great difficulty.

In cases of simple fracture occurring in the neighborhood of, or implicating large joints, passive motion is very commonly recommended at the end of from four or six weeks; I think, however, with Mr. Vincent, that this is often apt to do more harm than good, and is seldom required, the natural action of the muscles of the part being fully sufficient to restore the movements of the articulation, which may be assisted by friction and douches.

COMPOUND FRACTURES.

A compound fracture is that form of injury in which there is an open wound leading down to the broken bone, at the seat of fracture. These injuries are not only far more tedious in their cure than simple fractures, but infinitely more dangerous. The tediousness depends upon the communication of the fracture with the external air, causing it to unite by a slow process of granulation, instead of by the more speedy adhesive action that occurs in the simple form of injury. The danger is likewise partly due to the same cause, the process of granulation and suppuration being often attended by such profuse discharge of pus, from abscesses or long-continued exfoliation of bone; or by the supervention of secondary disease, such as hectic, phlebitis, pneumonia, or erysipelas, as to lead to the eventual loss of limb or life. Besides these dangers, which may be looked upon as of a remote kind, the violence that occasions a compound fracture often shatters the limb to such an extent, as to lead to the immediate supervention of traumatic gangrene, to the loss of life by hemorrhage, or to the certain and speedy disorganization of the limb, as the consequence of the reactionary inflammation.

As there are, therefore, not only prospective dangers of great magnitude to be encountered in these injuries, but also immediate risk of a very serious character to be met, the first question that always presents itself in a case of compound fracture is, whether the limb should be removed, or an attempt be made to save it. It is of great importance to settle this point at once, for, if amputation be determined upon, it should be had recourse to with as little delay as possible, there being no period in the progress of the case so favorable for the performance of this operation as the first four-and-twenty hours. Should an injudicious attempt have been made at saving the limb, the surgeon must wait until suppurative action has been set up before he can remove it; and then, he

will very commonly find that the occurrence of some of the diffuse inflammatory affections of an erysipeloid character will render any operation impracticable; or the supervention of traumatic gangrene may compel him to have recourse to amputation under the most unfavorable circumstances. At a late period in the progress of the case, amputation may be required, in order to rid the patient of a necrosed and suppurating limb that is exhausting him by the induction of hectic.

Though advocating the early performance of amputation in those cases which imperatively require it, I am aware that these operations are very commonly fatal, especially when practised near the trunk; but yet, this cannot with justice be urged as an argument against their performance, as immediate amputation should never be had recourse to except in the most severe cases, in which it is evident that the patient's life must in all probability be sacrificed, by the unsuccessful attempt to save the limb. In determining the cases in which immediate amputation should be performed, no very definite rules can be laid down, and much must at last be left to the individual judgment and experience of the surgeon. One will attempt to save a limb which another condemns. But, in coming to a conclusion upon this important question, he must bear in mind, that though it is imperative to do everything in his power to save a limb, yet that the preservation of the patient's life is the main point, and that that course is the proper one which offers the greatest prospect of effecting this. In coming to a conclusion on a question of such vital moment as this, he must be guided, not only by the nature and extent of the fracture, but by the age, constitution, and habits of the patient (p. 119).

Those fractures must be looked upon as most unfavorable, in which the wound is the consequence of the violence that breaks the bone, and in which there is much laceration of, and extravasation into, the soft parts; more particularly if the integuments are stripped off, portions of the muscular bellies protruding, and the planes of cellular tissue between the great muscles of the limb torn up and infiltrated with blood. Injuries of this description occurring in the lower extremity always require amputation. Now the danger to the patient increases almost in the exact ratio of the proximity of the injury to the trunk. Thus amputation of the thigh for bad compound fractures of the leg, though a very serious operation, is sufficiently successful; but when the femur itself is badly fractured, and amputation of the thigh high up is required, recovery can indeed but seldom be expected. In the arm, they are not so serious, and admit of the member being saved, unless the bones be greatly comminuted.

The complication of a compound fracture with the wound of a large joint, more especially if there be crushing or splintering of the bones which enter into its formation, when occurring in the lower extremity, is always a case for amputation. When the elbow and shoulder joints are extensively crushed and injured, amputation of the arm must be practised; but if the injury be localized, and the soft parts be in a favorable state, resection of the articulation may be successfully practised. These operations are usually somewhat irregular proceedings, being conducted according to the extent of the wound, and consisting rather in picking out the shattered fragments of bone, than in methodical excision.

When one of the larger arteries of the limb has been wounded by the violence that occasions the fracture, or has been lacerated by the broken bone, there may be copious arterial hemorrhage externally, as well as extravasation into the general cellular tissue of the limb. These cases most commonly require immediate amputation. But whilst the patient is being examined, and preparations made for the operation, care must be taken that a dangerous quantity of blood be not lost. This must be prevented by the elevated position and the application of a tourniquet. For want of this simple precaution I have

seen very large and even fatal quantities of blood gradually lost, by being allowed slowly to trickle from the wound.

In these cases it has been proposed, by some surgeons of great eminence, to enlarge the wound in the limb, or to make an incision down to the fracture, and to attempt to tie the artery where it has been injured. In most cases, however, this is scarcely practicable, as the surgeon would have to grope in the midst of bleeding and infiltrated tissues, and would experience the greatest possible difficulty in finding the wounded vessel, after a search which would materially tend to increase the disorganization of a limb. Even after the removal of a limb in this condition it is by no means easy to find the artery that has poured out blood; and how much more difficult must it not be to search for it successfully during life?

The ligature of the artery at a higher point of the limb does not hold out much prospect of success, for the same reasons that render its employment inadmissible in ordinary wounds of arteries. If, then, proper means directed to the wound, such as position, pressure, or perhaps the attempt at ligature if the artery be easily reached, are not successful, no course is left to the surgeon but to amputate the limb without delay. This is more especially the case if it be the lower extremity that is injured. In the arm there is a better prospect of our being able to arrest the bleeding without having recourse to this extreme measure.

If, however, the compound fracture be unattended by any of the complications that have just been mentioned, occurring in a young and otherwise healthy subject, we must, of course, attempt to save the limb, and shall generally succeed in doing so.

Treatment. — In the management of a compound fracture, special apparatus, such as M'Intyre's, Liston's, or the bracket-splints, double inclined planes, swing boxes, and fracture beds, are often necessary, in order to obtain access to the wound, so as to dress it properly, and to place the limb in the best position for union. In many cases the starch bandage may very advantageously be used, but it requires caution, as swelling and consequent strangulation of the limb may take place under it.

The reduction of compound fractures must be accomplished with the same attention to gentleness as in that of simple ones. In the majority of cases, no great difficulty is experienced in effecting this, and after it has been done, the limb should be placed on a well-padded splint, properly protected in the neighborhood of the wound with oiled silk, so as to prevent soiling of the pads by blood and discharge. In some cases, however, considerable difficulty arises in the reduction, from the protrusion of one of the broken fragments which has been driven through the skin, either by careless handling of the limb in carrying the patient, or else by the muscular contractions dragging the lower fragment forcibly upwards, and thus causing perforation of the integument. The protruded bone must, if possible, be gently replaced, by relaxing the muscles of the limb, and thus bringing the soft parts over it. In some cases, however, it is so tightly embraced by the skin, which appears to be doubled in underneath it, that enlargement of the wound becomes necessary before it can be replaced In other cases again it will be found that reduction cannot be effected or maintained, unless the sharp and projecting point of bone be sawn off. This must be done carefully by protecting the neighboring soft parts with a split card. The limb, as I have found in several cases in which it has been necessary to have recourse to this procedure, is not ultimately weakened by it.

After the reduction, the great object is, if possible, to convert the compound into a simple fracture by the closure of the external wound. If this can be accomplished, the tediousness and danger of the case are greatly lessened; the whole process of suppuration, with all its attendant evils, being saved to the patient. If the wound be small, clean cut, and occasioned by the protrusion of

the fragment rather than by the direct violence which occasions the fracture, we may hope to succeed in our object by following Sir A. Cooper's recommendation of applying to it a piece of lint soaked in its blood; or, what is better, saturated with collodion, and thus obtaining union by adhesion. If the wound be large, if a joint have been opened, if it have been inflicted by the same violence that breaks the bone, or if there be much bruising of the edges and surrounding tissues, with extravasation into the limb, this direct union cannot be expected to take place. Under these circumstances it is, I think, best to apply from the very first, water-dressing, so as to allow a vent for the discharges that take place after the first four-and-twenty hours.

After the position of the limb has been thus attended to, an endeavor must be made to moderate the local inflammatory action, and to lessen constitutional irritation. The local action may be moderated by the use of irrigation (fig. 45), and by the application of cold evaporating lotions to the part, which should be elevated and but lightly covered, the bed-clothes being well raised by means of a cradle, so as not to press on the limb, and to allow space for the evaporation of the cold lotion; care being taken, at the same time, that the bandages be applied very loosely, merely with a sufficient degree of force to retain the limb upon the splint, as inflammatory infiltration that might rapidly induce strangulation of the part is apt to ensue. The constitutional irritation must be subdued by the administration of opiates, together with an aperient, on the morning following the accident, which must be repeated from time to time during the first few days. Moderate antiphlogistic regimen must be had recourse to, and the patient be disturbed as little as possible. In many cases suppuration rapidly sets in, and if the patient be addicted to drinking, the constitutional disturbance soon assumes the irritative form; under these circumstances, it is of great moment that support, and even stimulants, be freely given; they must be allowed from the very first, and increased in proportion to the depression of the patient's strength, or as symptoms of nervous irritation come on.

If there be much extravasation of blood into and bruising of the soft parts, great tension of the limb, followed by unhealthy suppuration and sloughing, will take place in the neighborhood of the wound; free incisions are then required to remove the tension and strangulation of the tissues, and by letting out the broken-down blood and pus to lessen the risk of the occurrence of gangrene. So soon as suppuration is fairly established, a light poultice or thick water-dressing, should be applied, and the burrowing of matter prevented by making counter-openings where necessary, by the application of a compress, and by attention to the position of the limb. The fracture apparatus must be kept scrupulously clean, especially in summer; the bandages changed as often as soiled, and the pads well protected with oiled silk. During this period various complications, such as erysipelas, inflammation of the absorbents and veins, and low forms of pneumonia, are apt to occur, requiring special consideration and treatment; so also, if the discharge be abundant, hectic, with its sweats and gastro-intestinal irritation, may come on, requiring full support of the powers of the system, and the administration of the mineral acids and other remedies, according to circumstances. As the confinement to bed is necessarily very prolonged in these cases, often extending through many weeks and months, the state of the patient's back should be attended to, and he should early be placed upon a water-cushion, or hydrostatic bed, lest sores supervene. As the wound gradually heals, water-dressing must be substituted for poultices, so as not to sodden the parts and encourage suppuration, and in time the red or blue wash for the water-dressing. The bone will often be observed lying white and bare, bathed in pus, at the bottom of the wound. But though in this apparently unfavorable condition, it may recover itself; lymph gradually being deposited in points on its surface by the action of its own vessels, and this becoming vascularized, covering it with a layer of florid granulations. In other cases, necrosis

to a greater or less extent will take place, and perfect consolidation does not occur until the bone has separated. In some instances, a large quantity of provisional callus is thrown out, in which the necrosed bone is implicated, and then the process of separation becomes extremely tedious and protracted, and amputation may not uncommonly become necessary, from the powers of the patient being unable to bear up in so prolonged a struggle. So soon as some consolidation has taken place, the limb should be firmly put up in gutta-percha or leather splints, with a starch bandage, so as to enable the patient to be got out of bed, to change the air of his room, and thus to keep up his general health. In fitting these splints, care must be taken to make an aperture opposite the wound, through which it may be dressed (Fig. 82).

The time required for the proper consolidation of a compound fracture varies greatly, according to the amount of injury done to the bones and soft parts, the age and constitution of the patient. Under the most favorable circumstances, it requires double or treble the time that is necessary for the union of a simple fracture. Much stiffness of the limb from rigidity of the muscles and tendons will continue for a considerable length of time; this may gradually be removed by frictions and douches.

Secondary amputation may become necessary from the occurrence of traumatic gangrene, when it must be done in accordance with the principles already laid down when speaking of that operation; but more frequently it is required from failure of the powers of the patient in consequence of irritative and asthenic fever, induced by the general disorganization of the limb, or by hectic resulting from profuse suppuration and slow necrosis of the bones. Under these circumstances, the constitution suffers from the local irritation which is the source of the wasting discharge, but by removing this in time, and seizing an interval in which constitutional action may have been somewhat lessened, the patient's life will in all probability be preserved; the results of secondary amputation for compound fracture under these conditions being by no means unfavorable. Indeed, it is remarkable to see how speedily the constitutional irritative and hectic symptoms subside after the removal of the source of irritation, the patient often sleeping well, and taking his food with appetite the day after the operation.

The proper period to seize for the performance of secondary amputation in the earlier stages of the injury is often a most critical point. As a general rule, it may be stated, that if the limb be not removed during the first twenty-four hours, eight or ten days must be allowed to elapse before the operation is done; as during that time constitutional irritation and suppurative fever are of too general and active a character, to render fresh shock to the system admissible. But when once the actions appear to tend to localize themselves, the suppuration becoming more abundant, the redness extending but slowly, and the constitutional symptoms merging into an asthenic form, then the limb may be removed with the best prospect of success; the more the action is localized the better being the chance of the operation succeeding.

In many cases the symptomatic and suppurative fever so rapidly merge into the asthenic form, that the surgeon must seize the best moment he can for the performance of the amputation. Under these circumstances the operation is seldom very successful, the stump becomes sloughy, erysipelas or diffuse inflammation of the cellular tissues come on, or symptoms of pyemia set in, and the patient speedily dies. In other cases again, there is a marked interval between the stages of the inflammatory and suppurative fever, and the supervention of the typhoid symptoms, lasting for twelve or twenty-four hours, or even longer. During this the mischief may be looked upon as in a great measure of a local character; the constitution has been disturbed by the setting up of the inflammatory action, but this having terminated in suppuration, it has not as yet become seriously depressed by the continued irritation of the

discharge from the injured limb, or poisoned by the absorption of morbid matters from it.

The patient's powers must not, however, be allowed to sink to the last ebb before amputation is performed, as then, if the shock do not destroy life, intercurrent and visceral congestion, or some low form of inflammatory mischief, will not improbably prove fatal. Much as "conservative" surgery is to be admired and cultivated, and hasty or unnecessary operations to be deprecated, I cannot but think that the life of the patient is occasionally jeopardized, and even lost, by disinclination on the part of the surgeon to operate sufficiently early in cases of compound fracture, and by too prolonged attempts at saving the injured limb.

The success of the operation will in a great measure depend upon the after-treatment of the case. Large quantities of stimulants and support are often required in London practice to prevent the patient from sinking. I have often given with the best success eight or ten ounces of brandy, twelve or sixteen of port wine, with two or three pints of porter in the twenty-four hours after these operations, with beef-tea, arrow-root, or meat, if the patient will take it, and have found it absolutely necessary to do so lest the patient die exhausted.

At a later period than this, when some weeks or months have elapsed, and the fracture has not united, the bones necrosing, and the patient being worn out by hectic, amputation must be performed at any convenient moment, and is often then done with great success if it be not deferred too late; for here the mischief is entirely local, and the constitution suffering only by the debility resulting from it, quickly rallies when the cause of this is removed.

A fracture is occasionally so *badly set* that it becomes necessary to break or bend the callus, in order to improve the condition of the limb. When the displacement is angular, and the consolidation not very firm, this may be done pretty readily; but if the displacement be longitudinal, and much time has elapsed since the occurrence of the injury, it will be impossible to remedy the deformity. During the first four weeks the bond of union between the fragments is so yielding, that the angular displacement may be remedied by putting up the fracture afresh day by day, by the employment of pressure, and by the application of the roller in the opposite direction to that in which it had been previously applied. After this period, the deformity can only be remedied by forcibly bending or breaking the callus, and then putting up the fracture again, when speedy and perfect consolidation will ensue. In this way I have several times remedied fractures that had got into a faulty position, although five or six weeks had elapsed from the occurrence of the injury.

UNUNITED FRACTURES AND FALSE JOINTS.

Some bones when broken never unite by callus or plastic matter, their fragments merely being kept firm by the intervention of the aponeurotic structures of the part, as is the case with the patella. This, which is owing to a want of apposition of the fragments, and is dependent on the condition of the part, cannot be considered a diseased action.

It happens, however, occasionally in fractures of the shafts, or the articular ends of long bones, that proper union has not taken place at the usual time, or does not take place at all. This may be owing to one of three circumstances: 1stly, That no uniting material of a stronger kind than fibro-cellular tissue has been formed; 2dly, That the plastic matter that has been thrown out has only developed into fibrous tissue, not having undergone osseous transformation; or, 3dly, That true bony union has taken place, but, owing to some peculiar state of the patient's health, the callus has become absorbed, and the fracture loosened.

In the first and third conditions we have an *ununited fracture;* the ends of

the bone which are rounded and eburnated being merely connected by, and enveloped in, a loose fibro-cellular tissue.

In the second condition we have a *false joint*, the ends of the bone being tied together by strong fibrous bands. The structure of these false joints, which has been carefully studied by Rokitansky, presents two distinct varieties. In the first, which partakes of the character of a hinge joint, we find that the ends of the fracture are smoothed and rounded, invested with a dense fibrous periosteum, and united to one another by thick bands of ligamentous tissue, in such a way as usually to admit of considerable lateral movement, though sometimes they are tolerably firm.

In the other variety the joint partakes of the ball and socket character, usually to a very imperfect degree, but sometimes in a sufficiently well-developed manner, one end of the bone being rounded and invested by periosteum, the other, cup-shaped, and covered by firm smooth fibroid tissue. The bones are united by a kind of capsule, in which a synovia-like fluid has occasionally been found.

The form that the false joint will assume depends on the action of the muscles that influence it. Thus, when occurring in the shafts of long bones, when it is subjected to movements of flexion and extension, it will assume the hinge form; whilst when it is seated in the articular ends, where it is more subjected to movements of rotation, it will affect the ball and socket character.

The *causes* of ununited fracture and false joints are constitutional and local.

In some cases the constitutional cause appears to be a cachectic state of the system, occurring from some debilitating disease, such as phthisis, scurvy, or cancer, or from any depressing cause, in consequence of which there is not sufficient reparative power for the production or proper development of the plastic matter, by which the fracture should be united. If it have been deposited, it may, under the influence of these constitutional causes, again become absorbed, and the fracture thus be loosened; but in many cases no constitutional cause can be detected, the patient being in excellent health, strong, and robust. In spontaneous fractures, union seldom takes place very readily or perfectly.

Pregnancy is said to have a tendency to interfere with the proper union of a fracture; this, however, I consider doubtful, as I have had under my care, and have seen a considerable number of cases of fracture in pregnant women, which united in the ordinary manner.

Age does not appear to exercise any influence on the occurrence of disunion in fractures, which is indeed most common in the early and middle periods of life, when fractures are most frequently met with. I have on two occasions, in my own practice, known very firm and perfect consolidation of fracture of the shaft of the femur, take place in women of ninety years of age and upwards.

The local causes are various and important. The anatomical condition of the fragments, as regards their vascular supply, is perhaps that on which want of union is most immediately dependent. For proper union to take place, it is necessary that the callus be deposited from both sides of the fracture. If one fragment is so situated that sufficient blood is not sent to it for this purpose, not only may disunion, but necrosis, occur. This we see exemplified in fractures of the superior articular ends of the humerus and femur. In intracapsular fracture of the anatomical neck of the humerus, the globular head, being detached from all its vascular connections, may necrose. In intracapsular fracture of the neck of the femur, the head of the bone still retaining some vascular connection through the medium of the ligamentum teres, has sufficient blood furnished to it, to prevent its death, but not enough to form callus—hence fibrous union takes place. In the shafts of the long bones the degree of union will be dependent in a great measure on the conditions of the vascular supply to the fragments, through the medium of the nutritious artery. The influence of the rupture of the nutritious artery of the bone by the line of fracture running

across it, and thus interfering with the vascular supply of one of the fragments, has been investigated by Gueretin; and the occasional occurrence of atrophy of the bone after fracture, has been shown by Curling to be dependent upon the supply of arterial blood through this vessel being interrupted. Gueretin has collected cases that tend to prove the direct connection between the occurrence of ununited fracture, and the want of proper arterial supply to one of the fragments. Thus in the humerus the course of the nutritious artery is from above downwards, and of 13 cases of ununited fracture, 9 were found to be situated above the canal in which this vessel is lodged. In the forearm where the nutritious artery passes from below upwards, of 8 cases of ununited fracture, 7 occurred below this vessel, and only 1 above. Mr. Adams has, however, shown that the number and size, as well as position, of the nutrient arteries varies considerably, and hence the objection that non-union may occur in a fracture of any part of the shaft of a long bone, whereas the nutritious artery is only found at one spot, can scarcely be considered a very valid one. It is certainly owing in a great measure to this want of vascular supply that intracapsular fractures almost invariably unite by fibrous tissue rather than by bone, and that when bony union takes place, the callus is chiefly formed by the surface connected with the shaft. In some cases of intracapsular fracture of the humerus, no union whatever takes place, the detached fragment necrosing in consequence of its being entirely deprived of all supply of blood.

Some bones are much more liable than others to disunion of their fractures. According to the statistics collected by Norris, it would appear that the femur, the humerus, the bones of the leg, and of the forearm, and lastly the lower jaw, are those in which ununited fractures most frequently occur, and that in the order which has been given.

The occurrence of ununited fracture is occasionally attributed to the mobility or want of proper apposition of the fragments, and doubtless in some cases it may be so occasioned: but I believe that these causes are not nearly so frequent in their operation as the constitutional and local conditions that have already been pointed out. The interposition of a piece of muscle between the fragments, may occasion disunion. Of this I saw an interesting instance some years ago, in which want of union in a fractured femur was owing to the entanglement of a portion of the rectus muscle between the fragments.

The *treatment* of ununited fracture must chiefly be conducted with reference to the constitutional cause of the disunion, though local measures must not be neglected. If callus have not been formed, or, after formation, have been absorbed under the influence of a cachectic state of the system, the improvement of the patient's health, at the same time that the fracture is put up again firmly, so that the ends of the bone are brought in close apposition, may bring about perfect union. I have lately had under my care at the hospital, a man with ununited fracture of the femur from absorption of the callus four months after the occurrence of the injury, under the influence of incipient phthisis and debility induced by want of food, in whom perfect consolidation of the fracture has taken place, by giving him cod-liver oil and good diet, with rest in bed and a starch bandage to the limb. If there is no very evident cause for the disunion, putting up the fracture firmly in leather or gutta-percha splints, with a starch bandage, and then allowing the patient to move about upon crutches, so that his general health may not suffer, at the same time that a tonic plan of treatment is had recourse to, will occasionally suffice. This, however, can only be useful if but a short time, at most some months, has elapsed from the occurrence of the injury. Mr. Smith[1] (U. S.) has modified this treatment by putting the limb in an apparatus which combines pressure on the fracture with the power of movement. This plan, though somewhat tedious, occupying several months, appears to be successful, 10 cases out of 14 having been cured by it,

[1] [Vide Am. Journal of the Med Sciences, for January, 1855.]

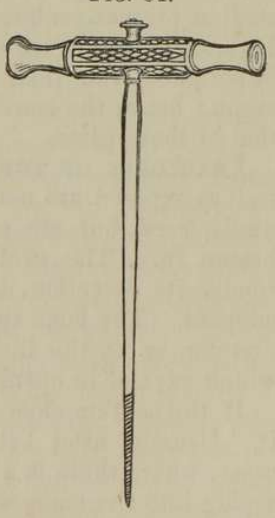
and has the merit of being unattended by danger. In some cases the empirical administration of mercury is attended with success. In a case of ununited fracture of the humerus that was admitted into the hospital under Mr. Liston, fifteen weeks after the occurrence of the injury, union took place within a month by putting up the limb in splints, and salivating the patient. When the disunion arises from malignant disease nothing can be done.

When the disunion has become very chronic, and a *false joint* has once formed, it will be necessary to have recourse to operative procedure before union can be attained. All operations that are undertaken in these cases are conducted on one or two principles; either with the view of exciting such inflammation in the false joint and the neighboring tissues, as will lead to the formation of lymph capable of undergoing osseous transformation; or else, by removing the false joint altogether, to convert the case into a recent compound fracture, and to treat it in the same way that such an accident would be managed. It can easily be understood that operative procedures conducted on these principles are of too serious a character to be lightly undertaken, or to be had recourse to until other measures have failed, the mortality following them being, even according to public statistics, considerable; and probably very much greater than has been laid before the profession.

Amongst the first set of operations, — those that have in view the excitation of sufficient inflammation to cause deposit of proper plastic matter, — the simplest procedure consists in the introduction of acupuncture needles, or in the subcutaneous section of the ligamentous band with a tenotome. In this way I have known union effected in a patient of Mr. Liston's, who had a false joint in the shaft of the femur, though not until after the fracture had been converted into a compound one, and much danger and suffering incurred. Four years after the consolidation of the ununited fracture, the patient was readmitted into the hospital, under my care, with fracture of the same bone two inches lower down than the former injury, and on this occasion, union took place in the usual manner and time without any difficulty.

The introduction of a seton across the false joint, though occasionally successful, is apt to give rise to dangerous and even fatal consequences, from arterial hemorrhage, erysipelas, diffuse inflammation and suppuration of the limb. The threads must not be left in beyond a few days, when sufficient action will have been induced. A modification of the seton consists in passing a silver wire around the fracture, and by gradually tightening this, to cut through the false joint at the same time that inflammatory action is excited in it. In performing this operation it must be borne in mind that large arterial branches and even the main trunk, especially in the thigh, may become firmly attached to the callus, so that unless care be taken they may readily be wounded.

Fig. 84.



Dieffenbach has excited the requisite degree of inflammation by driving with a mallet, three or four conical ivory pegs into holes bored by means of a gimlet or drill, (fig. 84,) in the ends of the fractured bone, which are exposed for this purpose. The soft parts are then laid down over them, and after a few weeks the pegs, which have loosened in consequence of the removal or absorption of their ends, should be taken out. It is not necessary or even desirable to endeavor to pin together the ends of the broken bone, but merely to introduce the pegs into the extremities of both fragments near to the seat of fracture. It is however, especially in ununited fractures of the femur and humerus that this can be successfully done; the irritation of the pegs

appearing to occasion an effusion of a large quantity of callus, sufficient for the consolidation of the fracture.

The operation of removing the false joint may be performed by cutting down upon it, and resecting the ends of the bones, or else by destroying the articulation with caustic potass. The excision of a false joint is necessarily a dangerous operation, and by no means a successful one; erysipelas, phlebitis, and diffuse suppuration of the bone occasionally supervening. Of 38 cases collected by Norris, in which the ends of the bones were either resected or scraped, 24 were cured, 7 derived no benefit, and 6 died. In those cases that are successful by this method, some shortening of the limb must be expected to result, and if the fracture be very oblique, it would of course be impossible to remove more than a very limited portion of it, and, consequently, very perfect union could scarcely be anticipated. The application of caustics to the exposed bones is so coarse and uncertain a method, as to find but little favor amongst surgeons of the present day.

On reviewing the various methods that have been recommended for the re-establishment of union between the separated fragments, it would appear that the excitation of proper inflammatory action, by the introduction of the seton, or by driving in ivory pegs, promises the most satisfactory result. It is by no means necessary to remove the fibrous band that intervenes between the the fragments in case of false joint, for if the proper amount of inflammatory action be set up, this either undergoes osseous transformation, or a sufficient quantity of callus is thrown out around it to consolidate the fracture. If union fails to be accomplished, amputation may be required as a last resource.

CHAPTER XV.

SPECIAL FRACTURES.

In considering the nature and treatment of fractures of particular bones, we shall at present confine our remarks to fractures of the face and extremities. Injuries of the bones of the head and spine derive their principal interest and importance, from their complication with lesion of some internal and contained organ; hence the consideration of these can with more propriety be referred to that of these parts.

Fractures of the Bones of the Face. — The *nasal bones*, being thin as well as exposed, are not unfrequently broken. When fractured they may remain undisplaced, but are more commonly depressed; the ridge of the nose being beaten in. The swelling and ecchymosis that usually attend this fracture render its detection difficult, and must be reduced before any treatment is adopted. The bone that is depressed should be raised with the broad end of a director, or by the introduction of a pair of polypus forceps into the nostril, which expand in opening, and push it into proper position.

If the septum alone be broken, the same treatment must be adopted towards it. Usually, after being replaced, the position is maintained; but in some cases, where there is a tendency to sinking of the nostrils, the introduction of a plug into the nares will be required to replace and retain the bones. The hemorrhage, which is usually pretty abundant, may be stopped by the application of cold, but occasionally the nostrils require plugging. If the lachrymal bone be broken, together with the nasal, the ductus ad nasum may be obstructed,

and the course of the tears diverted. In an injury of this kind I have seen extensive emphysema of the eyelids and forehead occur on the patient attempting to blow his nose. In some cases the injury inflicted to the nasal bone extends through the ethmoid to the base of the brain, and may thus occasion death. This I have seen happen from a severe blow on the face with a piece of wood.

The *malar and superior maxillary bones* are seldom broken unless great and direct violence has been had recourse to, and their fracture is usually accompanied by external wound, as in gun-shot injuries of these parts. More commonly the alveolar processes are detached, and the teeth loosened. The treatment then consists in binding the teeth together with gold wire. In some rare cases all the bones of the face appear to have been smashed and separated from the skull by the infliction of great violence. Thus, South relates the case of a man who was struck on the face with the handle of a crane, and in whom all the bones were separated and loosened, "feeling like beans in a bag." Vidal records the case of a man who, by a fall from a great height, separated all his facial bones. In fractures of the *zygoma* the fragments may be driven into the temporal muscle and produce so much difficulty to mastication, as to require removal.

The *lower jaw* is frequently broken, owing to its prominent situation; though its arched shape enables it to resist all but extreme degrees of violence. Fractures of this bone are usually compound, the laceration of the gum causing them to communicate with the external air. And not unfrequently they are comminuted as well, but yet from the freedom of the vascular supply to the bone, rapid and very perfect union takes place in it.

Fracture of the lower jaw may occur in various situations. I have seen it most frequently in the body of the bone, near the symphysis, extending between the lateral incisors; or between these teeth and the canine. The symphysis itself is not so commonly fractured, the bone being thick in this situation. The angle is frequently broken, but the neck and coronoid process rarely give way. The signs of fracture of the lower jaw are very obvious. The great mobility of the fragments, the crepitus, the irregularity of the line of teeth, and of the arch of the jaw, laceration of and bleeding from the gums, and dribbling of saliva, indicate unequivocally the nature of the injury. The displacement and mobility of the fracture are greater the nearer it is to the symphysis. If the bone happen to be broken on both sides of this line, the middle fragment is much dragged out of place by the depressor muscles of the lower jaw. In fracture about the angle and ramus, the deformity is not so great, owing to the muscles, that coat and protect either side of the bone in this situation, preventing the fragments being displaced.

The *treatment* is simple enough in principle, though often not very easy of accomplishment. It consists in maintaining the parts in apposition by suitable apparatus for four or five weeks, during which time mastication must be interdicted, the patient living on sop, soups, and fluid nourishment of all kinds, and talking prohibited. The apparatus that commonly suffices consists of a gutta-percha splint, moulded to the part, properly padded, and fixed on with a four-tailed bandage; the two fore-ends of which are tied behind the neck, whilst the two others are knotted over the top of the head. When the ramus is broken the side of the pasteboard cup splint should be made proportionately long. Any teeth that are loosened must be left in, as they will probably contract adhesions, and fix themselves firmly; and, if necessary, they may be tied to the sound teeth with gold wire, or dentist's silk. When depression, especially near the symphysis, is considerable, a clamp apparatus which fixes the chin and the line of teeth has been invented by Mr. Lonsdale for the purpose of steadying the fragments, and answers the purpose extremely well.

[The treatment adopted in this country, in those cases of fracture of the lower maxillary bone, which are attended with but little displacement, consists in the

application simply of retaining compresses and of Barton's or Gibson's bandage for the lower jaw. In oblique fractures accompanied with separation of the fragments, the use of the gutta-percha cup and the same bandage will generally suffice; the retention of the fragments in coaptation may also be materially assisted by the adjustment over the teeth and gums of the silver clamp proposed by Dr. Mütter.]

In fractures of the body of the lower jaw by gun-shot injury, there is great comminution and splintering of the bone, followed by copious and fetid discharge, which, being in parts wallowed, may reduce the patient to a state of extreme debility. In these cases, Dupuytren recommends the lower lip to be cut through, the splinters taken away, and, if necessary, a portion of the bone resected, so as to convert the wound into one similar to what results after the partial removal of the lower jaw for disease of the bone.

Fracture of the os hyoides is of very rare occurrence, and, though usually the result of direct violence, as a forcible grasp, has been seen by Oliver d'Angers to occur from muscular action. The signs are always very obvious, the fragments forming a sharp salient angle; there is much pain and irritation, increased by speaking and deglutition. There is usually salivation; and considerable difficulty in breathing may be present. Reduction is accomplished by pressing the fragments into apposition, either externally or by passing the finger into the mouth. Should one piece of the bone be driven much in, it might possibly require to be drawn forwards with a tenaculum. The head should then be fixed by a stiff pasteboard collar to prevent displacement.

The Clavicle is often broken, partly owing to its exposure to direct violence, and partly to its action in preserving the shoulder at a proper distance from the trunk, and being the only direct osseous support of the upper extremity, receiving, by transmission through the scapula, every shock that is communicated to the hand when the arm is in an extended position; hence blows on the shoulder and falls on the hand are common causes of fractured clavicle. This bone would be more frequently broken than it is, were it not that it resembles two segments of a circle looking in opposite directions, so as to form an 8 shape, which admirably enables it to withstand indirect violence. The clavicle may be fractured in three situations; 1stly, and most frequently, the great convexity is broken, the bone bending here when pressed upon from its extremity, the curve becoming increased, and at last giving way; 2dly, it may be fractured nearer the acromion under the acromio-clavicular and coraco-clavicular ligaments; and 3dly, its tip may be broken off external to the outermost point of insertion of the trapezoid ligaments between it and the acromion. The signs will depend upon the seat of fracture. When the bone is broken between the conoid and trapezoid ligaments, there is little, if any, displacement, but pain on pressure, some crepitus on moving the shoulders, and slight irregularity in running the finger along the bone. When the fracture is external to the trapezoid ligament, there is a remarkably oblique displacement of the scapular fragment, the articular surface of which is turned forwards and inwards, with a slight inclination downwards, nearly at right angles to the rest of the bone, apparently by the dragging of the weight of the shoulder, the point of which, with the scapula, is rounded forwards (fig. 85). When the fracture occurs about the middle of the bone, or at any part on the sternal side of the scapular ligaments, there is a remarkable degree of deformity, owing to the displacement of the outer fragment in a direction inwards and downwards. This displacement is owing to two causes, the weight of the arm dragging the fragment down, and the action of the muscles

Fig. 85.

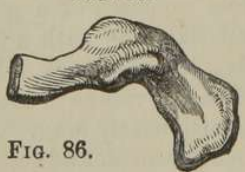
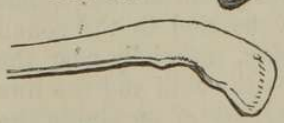


Fig. 86.



85. Fractured.
86. Healthy Clavicle.

that pass from the trunk to the shoulder drawing the scapula and the whole of the upper extremity, forwards and inwards towards the mesial line, when the support of the clavicle is removed. The outer extremity of the inner fragment appears to be elevated, the skin being drawn tensely over it; but this is rather owing to the depression of the outer portion of the bone; it is in reality kept fixed by the antagonism between the sterno-cleido-mastoid and great pectoral muscles. On looking at a patient with fracture of the clavicle in this situation, the nature of the injury is at once evident. The flattening of the shoulder with its point approximated towards the sternum, the great prominence formed by the end of the inner fragment over which the skin is tightly stretched, the sudden depression under this, and the crepitus, which can be easily induced by raising and rotating the shoulder at the same time that the elbow is pressed to the side, indicate in the most unequivocal manner the nature of the injury. The attitude of the patient is remarkable; he sits, leaning his head down to the affected side, so as to relax the muscles, and supports his elbow and forearm in the sound hand, in order to take off the weight of the limb.

Fracture of the clavicle in infants not unfrequently occurs, and is apt to be overlooked. The child cries and suffers pain whenever the arm is moved. On examination, an irregularity with some protuberance will be felt about the centre of the bone.

Comminuted fracture of the clavicle from direct violence is often a serious accident, as the subclavian vein and subjacent plexus of nerves, or the upper part of the chest, may be seriously injured as well. In a case of this kind that was under my care some time since, the subclavian vein was apparently wounded, great extravasation of blood taking place about the shoulder and neck, and the circulation through the veins of the arm so much interfered with as to threaten gangrene. The case did perfectly well, however, by the continuous application of arnica lotions to the shoulder, and attention to the position of the arm.

Treatment.—When the fracture occurs at the tip of the acromial end of the clavicle, a figure of 8 bandage round the shoulders, and keeping the arm in a sling, will prevent the tendency to displacement forwards.

When the bone is broken underneath the scapulo-clavicular ligaments, there is but little displacement, and the same treatment will suffice. But when the fracture is situated towards the middle of the bone, or indeed at any point to the inside of these ligaments, then the management is more difficult, and there are three principal indications to be attended to, in order to correct the triple displacement of the scapular fragment.

By placing a thick, wedge-shaped cushion with its broad end upwards in the axilla, and then bringing the elbow closely to the side, the outer fragment is drawn outwards, and by pressing the elbow well backwards, the tendency to rotation forwards of the shoulder is removed, and the broken bone brought into proper position. By elevating the shoulder, and taking off the weight of the arm by means of a short sling that passes well under the elbow, the displacement downwards is remedied. In applying the necessary apparatus care must be taken to bandage the fingers separately, to pad the palm of the hand with cotton wadding, and to apply a roller up the arm as high as the axillary pad. Before applying the roller, the elbow must always be flexed, otherwise undue and dangerous constriction of the arm may occur. The pad should be firm, made of bed-tick stuffed with bran, six inches long, five broad, and three thick at its upper part; the sling must support the elbow, and the hand should be well raised across the chest, so that the fingers rest upon the upper part of the sternum.

The elbow must be kept to the side by a few turns of a roller, or by means of a padded belt. In children, in whom these fractures often occur, there is frequently a difficulty in keeping the bandages properly applied; under these

circumstances the starch apparatus will be found very useful, care being taken to re-apply the apparatus so often as it becomes loose, lest deformity result. It has been recommended to treat fractured clavicles occurring in females, to whom any irregularity of union in this situation would be very annoying, by keeping the patient in bed for the first two or three weeks.

[Fig. 87.

]

[In fig. 87 is given a representation of the well-known apparatus of Dr. Fox, of Philadelphia, for the treatment of fractures of the clavicle. This dressing it will be seen is composed of a stuffed muslin collar for the sound shoulder, and of a firm wedge-shaped pad and sling for the injured arm. The tapes from the sling are attached in front and behind to the collar, which serves as the point of resistance. This apparatus has been subject to many modifications; the most valuable of which perhaps are those of Drs. Hamilton, Levis, and Bartlett.]

Fractures of the Scapula. — *Fracture of the body of the scapula* is not very commonly met with, and when it occurs, being always the result of considerable direct violence, it is usually associated with serious injury to the subjacent ribs and trunk. The thick layer of muscles overlying this bone not only protects it, but prevents displacement, and renders the detection of its fracture difficult. The fracture usually takes place across the bone, immediately below the spine, but occasionally it may be split longitudinally or starred. If ascertained, it should be treated by the application of a body-bandage.

FRACTURES IN THE VICINITY OF THE SHOULDER-JOINT.

These fractures are of common occurrence, and may happen either in the bony points of the scapula that overhang this articulation, or else in the upper end of the humerus. Not unfrequently there is double fracture in the neighborhood of this articulation; thus the acromion may be broken as well as the neck of the humerus. These complications necessarily throw some difficulty in the way of the diagnosis of these fractures. In many cases, also, the amount of contusion, and the rapid swelling that takes place, obscure the nature of the injury.

The *acromion*, forming as it does the very tip of the shoulder, is more frequently broken than any other of the bony structures in this neighborhood. The signs of this fracture are very obvious; when the acromion is broken off near its root, the arm hangs as a dead weight by the side, and the patient, feeling as if his arm were dropping off, supports it with the other hand. There is flattening of the shoulder, which is most marked by looking at the patient from behind; and the head of the humerus can be felt somewhat lower in the axilla than natural. On running the finger along the spine of the scapula, a sudden inequality in the line of the bone can be detected, and on raising the elbow and rotating the arm, crepitus can be felt, the rounded outline of the shoulder being restored.

In many cases the tip of the acromion only is broken off. When this happens, the nature of the injury may be suspected by the patient being unable to raise his arm to a level with his head, so as to touch the crown, owing to

some of the fibres of the deltoid having lost their points of attachment; and it may be determined by the existence in a minor degree of some of the preceding signs, which prevent the accident being confounded with paralysis of the deltoid from contusion.

The *treatment* consists principally in raising the elbow, so as to take off the weight of the limb, and to push up the acromion by the head of the humerus. At the same time a pad may be placed between the elbow and the side, in order to direct the arm somewhat upwards and inwards, and the limb must be fixed in this position by a bandage and sling. The union may take place either by bone or ligament.

The *coracoid process* is but seldom broken; never, indeed, except by very direct violence. There is in the museum of the University College a preparation showing a fracture of the base of this process, implicating and extending across the glenoid cavity. The attachment of such powerful muscles as the pectoralis minor, biceps, and coraco-brachialis would displace the fragment considerably, were it not that it is kept in position by the ligaments to which it gives insertion, and whose fibres are expanded over it.

The only treatment that can be adopted is to put the arm in a sling, and fix it to the side.

Fracture of the neck of the scapula very rarely occurs, and there can be little doubt that Sir A. Cooper and Mr. South are correct in stating, that cases so described, are, in reality, instances of fracture of the upper end of the humerus. There is, according to Mr. South, no preparation in any museum in London illustrating fracture of the neck of the scapula. Indeed, on looking at the great strength of this portion of the bone, and the way in which it is protected by the other parts about the shoulder, it is difficult to understand how it can be broken, except by gun-shot violence.

FRACTURES OF THE HUMERUS. — In studying the fractures of the humerus, we must divide that bone into three parts, — the upper articular end, the shaft, and the lower articular extremity.

Fracture of the upper articular end of the humerus not unfrequently occurs, constituting an important class of injuries which have been carefully studied by Sir A. Cooper, and more recently by Mr. R. W. Smith, whose work on fractures deserves the attentive perusal of every practitioner.

Five kinds of fracture of the humerus are met with in the immediate vicinity of the shoulder-joint. Two of these are *intracapsular*, viz., *simple* fracture of the *anatomical* neck, and *impacted* fracture of this portion of the bone. The remaining three are *extracapsular*, viz., fractures of the *surgical* neck, — *simple*, and *impacted;* and *separation of the great tubercle* from the head of the bone.

Intracapsular fractures of the neck of the humerus. — When the fracture occurs at the *anatomical* neck, the head of the bone is detached from the tubercles, a little above, or, at the line of insertion of the capsule. These fractures are occasioned by severe falls on the shoulder, and are most frequently met with in adults.

The signs of this injury are by no means very distinct, though much light has been thrown upon them by the recent labors of Mr. Smith. There is loss of motion in the shoulder, with some swelling and considerable pain; but there is some deformity about the shoulder, and an irregularity, produced by the upper end of the lower fragment, can be felt towards the inner side of the joint; crepitus is easily produced; and there is, on measurement from the acromion to the olecranon, shortening to the extent of about one-third of an inch.

When this fracture is *impacted*, the upper fragment penetrates the lower one. In consequence of this, the axis of the humerus is directed somewhat inwards towards the coracoid process: here also some irregular osseous swelling may be

detected. The head of the bone can be felt in the glenoid cavity, but it is not in the axis of the limb, the elbow projecting slightly from the side, there being at the same time a hollow under the acromion. There is consequently more deformity about the joint in the impacted than in the simple intracapsular fracture, with the same impairment of motion, but only slight crepitus on firmly grasping the shoulder and rotating the elbow.

In fracture of the anatomical neck of the humerus the portion of bone broken off is truly a foreign body in the joint, and being unconnected with any ligamentous structure, may perish, and thus give rise to destruction of the articulation. When this does not take place it is probable that impaction of the fragment has occurred, and that thus its life is maintained; or it may happen, as Mr. Smith supposes, that its vitality is occasionally preserved in consequence of some partial union being kept up between it and the rest of the bone by untorn shreds of capsule. In either case the principal reparative efforts are made by the lower fragment, which deposits callus abundantly.

Treatment.—As there is often much swelling from contusion in these cases, local antiphlogistic treatment by means of leeches and evaporating lotions should be had recourse to, for a few days. A pad may then be placed in the axilla, and a leather or gutta-percha cap fitted to the shoulder and upper arm, the limb having previously been bandaged. The hand must be supported in a sling, and the elbow fixed to the side. In examining and reducing these intracapsular fractures, no violence should be employed, lest the impaction of the fragment be disturbed, or portions of untorn capsule, on which the ultimate osseous repair of the injury is dependent, be broken through.

Extracapsular fractures of the neck of the humerus.—In these injuries, the bone is broken through the *surgical* neck, or that portion which is below the tubercles, but above the insertions of the pectoralis major, latissimus dorsi, teres major, and deltoid muscles. This accident may occur in children as well as in adults; in the former the separation taking place through the line of junction between the epiphysis and the shaft of the bone. In this fracture there is double displacement; the head of the bone and upper fragment are rotated outwards, being under the influence of the muscles inserted into the great tubercle, whilst the shaft is drawn upwards and inwards under the coracoid process, by the muscles going from the trunk to the arm, and by the flexors of the limb.

The signs of this fracture are sufficiently obvious. The glenoid cavity is filled by the head of the bone, which can be felt in it. Below this there is a depression; crepitus is easily produced, and there is great mobility of the lower fragment, and shortening of the limb to the extent of from three-quarters to one inch; but the most remarkable sign is the prominence formed by the upper end of the shaft of the humerus, which projects under the integuments, and can readily be felt under the coracoid process, especially when the elbow is pushed upwards and rotated. The axis of the bone is also directed obliquely upwards and inwards towards this point. In consequence of this fragment, which is often very sharp and angular, irritating the nerves of the axillary plexus, a good deal of pain is complained of in the arm and fingers. This sign, however, is not met with in children, owing to the greater smoothness of the fractured surfaces.

The *impacted* extracapsular fracture of the neck of the humerus has been especially treated of by Smith in his very excellent work on fractures. In this injury the superior fragment being penetrated by the inferior one, the continuity of the bone and its firmness are in a great measure preserved; hence, the usual signs of fracture, such as mobility, displacement, and crepitus, are not readily obtainable, and indeed the signs of this injury are chiefly negative. Thus, there is impairment of motion, slight deformity about the joint and upper part

of the arm, and some crepitus; but only obtainable with difficulty, and by firmly grasping the head of the bone whilst the elbow is being rotated.

The *treatment* usually recommended consists in bandaging the limb, putting a pad in the axilla, a leather or gutta percha cap over the shoulder, bringing the elbow well to the side by means of a bandage, and supporting the hand only in a sling, so that the weight of the arm may be allowed to drag on the lower fragment, and thus lessen the displacement.

In the management of these fractures, I have found a very convenient apparatus to consist of a leather splint about two feet long by six inches broad, bent upon itself in the middle, so that one half of it may be applied lengthways to the chest, and the other half to the inside of the injured arm, the angle formed by the bend, which should be somewhat obtuse, being well pressed up into the axilla. In this way the limb is well steadied and the tendency to displacement inwards of the lower fragment corrected.

In some cases fracture of the neck of the humerus is followed by atrophy of the bone, though good union has taken place.

Compound fracture of the surgical neck of the humerus is not of common occurrence. Recently I had a case under my care in which the accident happened to a lad from a fall out of a window. The fracture was transverse and the upper extremity of the lower fragment protruded through the deltoid to the extent of an inch and a half. It was reduced with difficulty; as great irritation was set up around the seats of injury, and as there was a tendency to protrusion of the upper extremity of the lower fragment, this was turned out by enlarging the wound, and about an inch and a half of it sawn off. Union took place between the fragments, and recovery was effected with a very perfect arm.

Separation of the great tubercle of the humerus occasionally occurs from falls and blows upon the shoulder; but more commonly as the result of the violent action of the three external rotator muscles, which are inserted into it. In this injury there is a double displacement; the tubercle is carried upwards and outwards away from the head of the bone, and under and external to the acromion process; the head is drawn upwards and inwards by the muscles passing from the trunk to the arm, as well as by the flexors of the arm, in such a way that it lies upon the inner edge of the glenoid cavity under the coracoid process, and is indeed almost luxated. The consequence of this double displacement is a great increase in the breadth of the shoulder, which is nearly double its natural size; on examination a rounded tumor, the head of the bone, movable on rotating the arm, can be felt under the coracoid process, whilst another osseous mass, the great tubercle, may be felt at the outer and back part of the joint; between these a sulcus is perceptible, and crepitus may be felt by bringing the two portions of bone in apposition and rotating the arm. This accident, which is of rare occurrence, has been most carefully described by Guthrie and Smith, to whom a knowledge of its pathology is due.

The principle of *treatment* consists in an attempt to bring, and retain the detached tubercle in contact with the head of the bone; this may be done either by mechanical means, or by relaxation of the muscles.

The treatment by mechanical means consists in placing a pad in the axilla, and bringing the elbow to the side so as to throw out the head of the bone, at the same time that, by means of a compress, the tubercle is pressed into proper position, the arm being supported in a sling. The treatment by relaxation of the muscles consists in elevating and extending the arm from the trunk; in carrying this out, it is necessary that the patient be confined to bed, the arm being supported on a pillow.

Fractures of the shaft of the humerus are usually somewhat oblique from above, downwards and outwards. The nature of the accident can be at once detected by the great mobility of the fragment, the ready production of

crepitus, and the other ordinary signs of fracture. The displacement usually consists in the lower fragment being drawn upwards and to the inner side of the upper one, which is often somewhat everted. The treatment is of the simplest character, flexing the elbow, bandaging the arm, and the application of two or three well-padded splints, the inner one of which should be rectangular, being all that is necessary. In applying a splint to the inner side of the arm, care must be taken that it do not press upon the axillary vein, lest œdema of the limb occur.

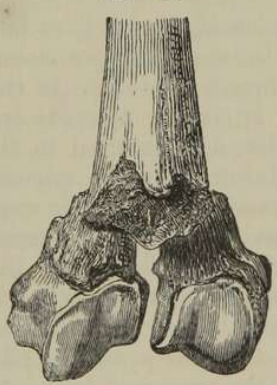
FRACTURES IN THE VICINITY OF THE ELBOW-JOINT

May occur through any of the osseous prominences in this situation. They are very commonly complicated with dislocation, with considerable contusion of and injury to the joint, or perhaps with comminution of the bones and considerable laceration of the soft parts covering them. In most cases swelling speedily comes on, tending to obscure materially the nature of the injury.

FRACTURES OF THE LOWER ARTICULAR END OF THE HUMERUS.—*The separation of the lower epiphysis of the humerus* in children before its ossification is complete, is by no means an unfrequent accident, the fragment being carried backwards, with the bones of the forearm connected with it, so as to cause considerable displacement posteriorly. It may readily be displaced, but slips out of its position again, with crepitus, so soon as it is left to itself.

A transverse fracture of the lower end of the humerus, just above the elbow, occasionally occurs in adults. In these cases the displacement backwards of the forearm and lower fragment, the pain and crepitus, indicate the nature of the accident.

FIG. 88.



Fracture of either condyle of the humerus may arise from blows and falls on the elbow. There is considerable pain about the seat of the injury, but usually not much displacement, unless, as in fig. 87, there is a transverse fracture as well. Crepitus, however may readily be felt by rotating the radius, if it be the external condyle that is injured; or by flexing and pronating the forearm, if it be the internal condyle that has been detached.

The *treatment* of all these injuries must be conducted on very similar principles. The swelling and inflammatory action, which rapidly supervene, usually require local antiphlogistic treatment, the application of cold lotions, or of irrigation, the arm being flexed, and supported in an easy position on a proper splint. After the subsidence of the swelling, the fracture, whatever be its precise nature, is best maintained in position by being put up in angular splints, the forearm being kept in the mid-state between pronation and supination, and well supported in a sling. It is in these particular fractures that passive motion, if it ever be employed, may be had recourse to, a tendency to rigidity about the joint being otherwise often left. The motion should be begun in adults at the expiration of a month or five weeks; in children at the end of three weeks after the occurrence of the accident.

[In fractures involving the articulation of the elbow joint, the main difficulty in the treatment arises from the nature of the displacement of the lower fragments of the humerus. In consequence of the action of the muscles which pass from the arm to their insertion upon the forearm, viz., the biceps, triceps, and brachialis anticus, there is a constant tendency to retraction upwards of the forearm, and necessarily a corresponding displacement of the lower fragments

of the fractured bone. The indication in the treatment is therefore evidently —to keep up a proper degree of extension of the forearm, and thus to prevent the displacement above described. This we believe can best be accomplished by the use of the splint recommended by the late Dr. Hewson. This splint is angular, with a flexible joint, and so carved as to fit with accuracy upon the anterior portion of the arm and forearm. By this means a sufficient degree of extension of the forearm is obtained, and at the same time all the tendency to excoriation over the condyles, so often observed after the application of the lateral angular splints, prevented.]

The only fracture of the bones of the forearm that commonly occurs in the vicinity of the elbow-joint, is that of the *olecranon;* this may happen from falls upon the elbow, or from muscular action. The displacement is usually considerable, the fragment which is detached being drawn upwards by the triceps muscle. Occasionally, however, when the ligamentary expansion of the tendon of this muscle is not torn through, there is but little separation of the fragments. In the majority of cases, as it takes place from direct violence, there is much swelling about the joint, and not unfrequently the fracture is compound. The treatment consists in keeping the arm extended for about three weeks, by means of a light wooden splint applied along its anterior aspect; at the end of this time it may be gradually flexed. When the separation of the fragments is considerable, bony union does not take place; but when the tendinous expansion of the triceps has not been torn, the fracture unites by osseous deposit.

Fracture of the coronoid process is an accident of very rare occurrence, but would occasionally appear to happen, by falls upon the palm of the hand, the forearm being forcibly driven backwards. It may occur from the contraction of the brachialis anticus muscle, as in the case of a boy, reported by Mr. Liston, who, by hanging from a high wall for too long a time, met with this fracture. When it exists, the forearm is dislocated backwards, crepitus being detected as it is replaced in position. The treatment consists in flexing the elbow, placing the arm in a sling, and keeping the joint quiet. Union takes place by ligament and not by bone.

Fractures of the middle of the forearm are of very common occurrence, both bones being usually broken, with much shortening, angular displacement, and crepitus. Occasionally one bone only is fractured, from the application of direct violence. When this is the case, more attention will be required in establishing the precise nature of the injury.

The treatment is simple; a splint somewhat broader than the arm, should be placed on either side of it, and a narrow pad laid along the interosseous space, in order that the patency of this may be preserved; no bandage should be placed under the splint. If masses of callus happen to be thrown out across this interval, the prone and supine movements of the hand will be lost, and the utility of the limb greatly interfered with.

Compound fractures of the elbow-joint are necessarily serious accidents. If the articulation be simply opened with little laceration of the surrounding soft parts, and no comminution of the bones, the limb may very commonly be preserved by the employment of active antiphlogistic treatment. If the bones be much shattered, the soft parts not being seriously implicated, removal of the splinters, and more or less complete resection of the injured joint, will enable the surgeon to save the rest of the limb. But if the soft parts be extensively contused and torn, as well as the bones comminuted, amputation of the arm may be required.

Compound fractures of the forearm seldom give much trouble or require amputation, but they very commonly lead to obliteration of the interosseous space, and thus impair the after utility of the limb.

FRACTURES OF THE LOWER EXTREMITY OF THE RADIUS, near the wrist, are

of common occurrence, from falls upon the palm of the hand, giving rise to very considerable and remarkable displacement, which has often been mistaken for dislocation of this joint. The importance of these fractures, not only in a diagnostic point of view, but also in reference to their treatment, has caused them to be carefully studied by surgeons, and their nature and pathology have been especially investigated by Collis, Goyrand, Voillermier, Nélaton and Smith.

The *signs* of a fracture of the radius in the neighborhood of this joint are so peculiar, that, when once seen, they may always be recognized without difficulty as diagnostic of the injury. The deformity occasioned by this accident gives rise to a remarkable undular distortion of the wrist. On looking at the injured limb sideways, it will be seen that there is a considerable dorsal prominence apparently situated on the back of the carpus. Immediately underneath this, on the palmar aspect of the wrist, just opposite the annular ligament, there is a remarkable hollow or arch most distinctly marked at, and indeed confined to, the radial side of the arm; a little above this, that is to say, on the lower part of the palmar aspect of the forearm, there is another rounded prominence, not nearly so large or distinct however as the one on the dorsal aspect. On looking at the back of the hand it will be seen to be placed somewhat obliquely to the axis of the forearm, the ulnar border being somewhat convex, and the styloid process of this bone projecting sharply under the skin (fig. 89). The radial side of the wrist is, on the contrary, somewhat concave, appearing to be shortened.

Fig. 89.

The pain about the seat of injury is very severe, and is greatly increased by moving the hand, especially by making any attempt at supination. The hand is perfectly useless, the patient being unable to support it. All power of rotating the radius is lost, the patient moving the whole of the arm from the shoulder at once, and thus apparently, but not really, pronating and supinating it. Crepitus can often be felt, but in some cases the most careful examination fails to elicit it, unless the hand be very forcibly drawn downwards and then rotated.

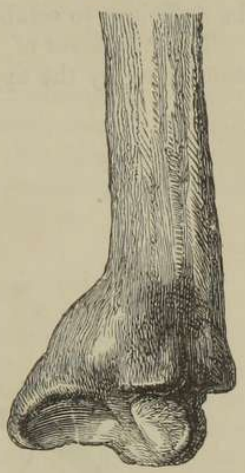
Fig. 90.

This fracture usually occurs from half an inch to an inch above the articular surface of the radius. The cause of the particular deformity that is observed, and indeed the general pathology of the injury, has been the subject of much discussion, in a great measure owing, I believe, to the opportunity of dissecting recent fractures of this kind being not very frequent. Some years ago I had an opportunity of dissecting and carefully examining the state of a limb in a woman who died in University College Hospital, twelve days after meeting with this accident. On examining the left arm, which presented all the signs of this injury in a marked degree (fig. 89), a transverse fracture of the radius was found about an inch above its articular surface. The lower fragment was split into three portions, between which the upper fragment was so firmly impacted to the depth of more than half an inch as to require some force in its removal. The three portions into which the lower fragment was split were of very unequal size; the two posterior ones being small, consisting merely of scales of bone, the third fragment, the largest, comprising the whole of the articular surface of the radius, which was some-

what tilted upwards and backwards. To this fragment were attached the supinator longus, and the greater part of the pronator quadratus; the ligaments and the capsule of the joint were uninjured.

This case presented the appearances usually met with in this kind of injury, the lower fragment being displaced in such a way that its articular surface looks slightly upwards, backwards, and somewhat outwards, so as to be twisted as it were upon its axis (figs. 90, 91). The upper fragment is always found in a state of pronation, and in many cases is driven into and firmly impacted in the lower one.

Fig. 91.



To what is this displacement of the lower fragment due? Is it to muscular action, or to the peculiar manner in which the two fragments are locked into one another? Muscular action cannot, I think, be considered the sole, or indeed the chief cause of this deformity, for although the supinator longus is attached to the lower fragment, and with the radial extensors would influence the position of this portion of the bone, yet it must be borne in mind that their antagonists, the pronator quadratus and the flexor muscles of the wrist, are likewise attached to, and exercise their action directly upon this fragment, and would have a tendency to counterbalance the action of the supinators and extensors. These muscles also are by no means powerful, and would certainly not be able to withstand ordinary efforts at remedying the displacement, which in many cases are unsuccessful. That the deformity is the result of impaction, I feel convinced, notwithstanding the elaborate argument of Mr. Smith in opposition to this view, and my conviction is founded on an examination of several specimens of consolidated fracture of the radius preserved in the different collections in London, upon the dissection of the case already alluded to, and upon the difficulty in any other way of accounting for the occasional impossibility of properly reducing these fractures. The great traction that is usually required to remove the deformity, and the absence of distinct crepitus in some cases, until after forcible traction has been employed, also indicate the existence of impaction. At the same time I do not doubt that it occasionally happens that these fractures are not impacted; this would appear to be the case in those instances in which crepitus is easily detected, and the fracture readily reduced.

The mode in which the impaction and deformity occur, appear to me to be as follows. When a person falls on the palm of the hand, the shock, which is principally received on the ball of the thumb, and the radial side of the wrist, is not directed immediately upwards in the axis of the radius; but the force impinging in a direction obliquely from before backwards, and from without inwards, as well as from below upwards, has a tendency to rotate the lower fragment on its own axis, and to tilt the articular surface somewhat upwards and outwards. As the upper fragment descends, its posterior surface of compact tissue is forced into the cancellous structure of the lower fragment, to such a depth as will admit of the two anterior portions of compact tissue coming in contact, and thus the upper line of compact tissue is driven into the lower fragment to an extent corresponding to the degree with which the fragment is rotated upwards and backwards. If the bone be brittle, or the force be continued after this amount of impaction has taken place, the lower fragment will be splintered.

The prominence of the styloid process of the ulna, is the result of the shortening of the radial side of the wrist and hand consequent upon the impaction.

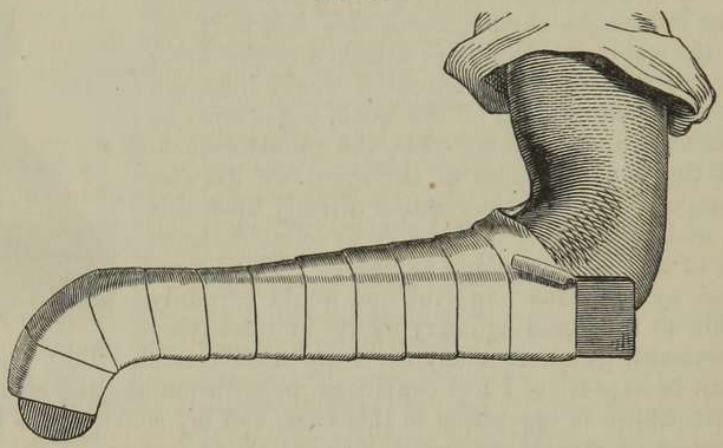
Besides this injury, Mr. Smith has described a fracture of the lower end of the radius in consequence of falls upon the back of the hand, in which the infe-

rior fragment is displaced forwards. In these cases the character of the deformity indicates the nature of the injury. It can readily be reduced, with a feeling of crepitation, by traction.

In another variety of fracture in this situation, the lower end of the radius and that of the ulna are broken off, resembling very closely dislocation of the wrist backwards. But the fact of the existence of grating, of the ready reduction of the swelling, and of the styloid processes of the radius and of the ulna continuing to be attached to, and following the movements of the carpus, will be sufficient to establish the diagnosis.

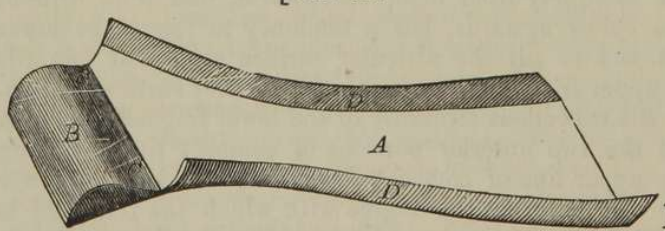
The *treatment* of the ordinary fracture of the radius near the wrist is best conducted by the apparatus introduced by Nélaton (fig. 92). This consists of

Fig. 92.



a pistol-shaped wooden splint, which is placed along the outside of the arm, reaching from the elbow to the extremity of the fingers. Forcible extension and counter-extension should be practised with the view of disentangling the fragments, and removing the dorsal prominence. The splint, thickly padded opposite the lower fragment should then be applied to the outer side of the arm, and the hand being well brought down to its ulnar side, should be bandaged to the bent part of the splint. Another short splint, reaching from the bend of the elbow to the lower extremity of the upper fragment should now e placed along the inside of the arm, after having been well padded along its radial border, so as to counteract the tendency to pronation of this part of the bone. The arm must then be placed in a sling. The fracture unites in the course of a month or five weeks, and passive motion of the joint may then be commenced, but it will be at least three months before the stiffness of the hand and wrist are so far diminished, even by the use of frictions and douches, as to enable the patient to use the fingers. It sometimes happens that the radius on both sides is broken at the same time in this situation, constituting a somewhat serious condition, inasmuch as the patient is not able to feed or assist himself in any way during the treatment.

[Fig. 93.



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[In the treatment of fractures of the lower end of the radius, Dr. J. Rhea Barton, of this city, some years since, recommended the application of two straight splints, and of two compresses, one to be applied over the lower frag-

ment, and the other beneath the inferior extremity of the upper. Of late, this dressing has been somewhat superseded by the box splint of Dr. Bond (fig. 93), in which the palm of the hand rests upon a block, the extremities of the fingers remaining free. By retaining the limb in this position the muscles will be relaxed, and no undue pressure exerted upon their tendons. A better chance of escaping permanent stiffness will be afforded; should this, however, result, despite the efforts of the surgeon "the hand will not entirely have lost its uses. For the hand, thumb, and fingers being placed very nearly in the position of their most frequent uses, the interossei, the lumbricales, and the several short muscles of the thumb, will, by causing only a very limited motion, enable the hand to perform very many of its useful functions."]

Fractures of the metacarpus and fingers are of so simple a character in every way as scarcely to call for detailed remarks. In the treatment, rest of the part upon a leather or pasteboard splint is all that is requisite. In compound fracture of these bones, every effort should be made to save the part; if removal become necessary, it should be to as limited an extent as possible.

FRACTURES OF THE LOWER EXTREMITY.

In fractures of the pelvis, the danger depends not so much on the extent of the fracture as on its complication with internal injury, and the violence with which it has been inflicted. Fracture may extend in any direction across the pelvic bones, though most commonly it passes through the rami of the pubes and ischium, and across the body of the ilium, near the sacro-iliac articulation In some cases the symphysis is broken through, and in others the fracture extends across the body of the pubes.

It occasionally happens that a portion of the crest of the ilium is broken off, but this is of little consequence, even though the bone continues depressed. When the rami of the pubes and ischium, or the whole body of the ilium, are broken through, there is, of course, considerable danger from internal injury. If the patient escape this, the fracture, however extensive it may be, may unite favorably. I had lately a patient under my care at the hospital, with a fracture extending through the rami of the pubes and ischium, and across the ilium, in a line parallel with, and close to the sacro-iliac symphysis, so as completely to detach one half of the pelvis, but who recovered without any bad consequences occurring.

The nature of the injury is usually apparent from the great degree of direct violence that has been inflicted upon the part, from the pain that the patient experiences in moving or in coughing, with an impossibility to stand, in consequence of a feeling as if the body were falling to pieces when he attempts to do so, with mobility of the part and crepitus on seizing the brim of the pelvis on either side and moving it to and fro. In examining a patient with suspected fracture of the pelvis, care should, however, be taken not to push the investigation too closely, lest injury be inflicted by the movement of the fragments. In those cases, indeed, in which the fracture does not extend completely across the pelvis, or in which it is seated in the deeper parts of the ischium, an exact diagnosis may be impossible.

In fractured pelvis, the principal sources of danger arise from injury to the bladder and urethra, with consequent extravasation of urine; from laceration of the rectum, or fracture of the acetabulum; and in examining the pelvis no rough handling should be allowed, lest injury to these parts be inflicted by the fragments.

In the *treatment*, the first thing to be done is to pass a catheter into the bladder, in order to ascertain the condition of the urinary apparatus; if it be injured, measures that will be hereafter described must be had recourse to. The next thing is to keep the part perfectly quiet, so as to bring about union

With this view, a padded belt, or a broad flannel roller, should be tightly applied round the pelvis, the patient lying on a hard mattress. The knees may then be tied together, and a leather or gutta-percha splint put upon the hip of the side affected, so as to keep the joint quiet, and to prevent all displacement of the fragment.

Fracture of the acetabulum is of rare occurrence, and can only happen when the pelvic bones have been extensively broken. There is a preparation in the University College Museum, exhibiting a comminuted fracture of this articular surface as well as of the ilium. Sanson and Sir A. Cooper have seen the acetabulum separated into its three primitive fragments, and the head of the femur driven into the pelvic cavity.

As some displacement of the head of the femur would occur in these cases, they might be mistaken for dislocation, more especially as inversion of the foot has been noticed. The crepitus and free mobility would however serve as distinguishing signs.

With regard to treatment, the application of a leather splint and broad padded belt, with local antiphlogistic means, is all that can be done.

Fracture of the sacrum is an extremely rare occurrence. The only instance with which I am acquainted is in the Museum of the College of Surgeons The *coccyx*, though more exposed, is also but seldom broken. When fractured, the pain is usually severe, there being much contusion and inflammation of the ligamentous expansion that covers this bone, so that the patient is scarcely able to walk or to sit. This pain may continue for months and even years. South relates the case of a gentleman who broke his coccyx by sitting on the edge of a snuff-box, and who suffered such severe pain that he was obliged to wear a pad on either tuberosity of the ischium, in order that the coccyx might be in a kind of pit, and free from all pressure when he sat.

FRACTURES OF THE FEMUR are of great practical interest, from their frequency and severity. They may occur in the upper articular end of the bone, in its shaft, or in its lower end. In these different situations every possible variety of fracture is often met with.

Fractures of the pelvic end of the bone may be divided into those that occur *through the neck within* the capsule of the joint, — those that occur *outside* the capsule, and into those that implicate the *trochanter* alone.

Intracapsular fractures of the neck of the femur are of two kinds, the *simple*, in which the bone is merely broken across, and the *impacted*, in which the lower portion of bone is driven into the upper fragment.

The intracapsular fracture may also be looked upon as a special injury of advanced life, being but seldom met with in persons under fifty. Thus Sir A. Cooper states that of 251 cases that he met with in the course of his practice, only 2 were in persons below this age. It may, however, happen at an early period of life. Thus, Mr. Stanley has recorded the case of a lad of eighteen, who met with this injury. Another remarkable circumstance in connection with it is, that it commonly happens from very slight degrees of violence, indeed almost spontaneously. Thus, the jarring of the foot in missing a step in going down stairs, catching the toes under the carpet, tripping upon a stone, or entangling the foot in turning in bed, are sufficient to occasion it. It is especially in women that this injury is met with.

The occurrence of this fracture in old age is owing indirectly to the changes in structure, shape, and position of the head and neck of the femur with advancing years. The cancellous structure of these parts becomes expanded, the cells large, loose, and loaded with fluid fat. The compact structure becomes thinned, and proportionally weakened, especially about the middle and under part of the neck, which, appearing to yield to the weight of the body, is shortened; and instead of being oblique in its direction, becomes horizontal, inserted nearly at right angles into the shaft. In consequence of these changes in struc-

ture and position, it becomes less able to bear any sudden shock by which the weight of the body is thrown upon it, and snaps under the influence of very slight degrees of violence. When it breaks, the capsule may remain uninjured, but the prolongation of it which invests the neck of the bone is usually torn through. In some cases, however, this cervical reflexion is not ruptured, the lower portion of it especially often remaining for some length of time untorn, at last, however, giving way under the influence of the movements of the limb, or by being softened by local inflammatory action. As the violence occasioning the fracture is generally but slight, and as the vascularity of this portion of the bone is trifling in old people, there is but little extravasation of blood.

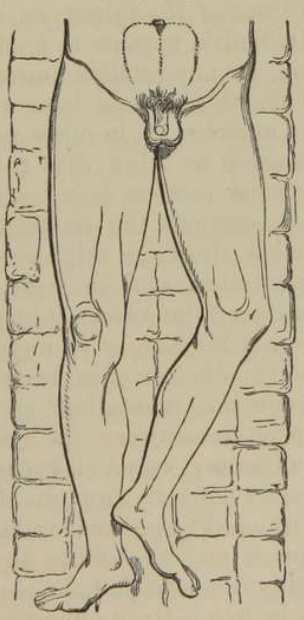
The fragments are almost always so separated that the fractured surfaces are not in apposition: the upper end of the lower fragment is drawn above and to the outer side of the head of the bone, and at the same time is twisted so that its broken surface looks forwards. The head remains in the acetabulum, attached by the ligamentum teres, and sometimes preserving a connection with the lower fragment, through the medium of some untorn portions of the fibrous membrane investing the neck. The capsule is uninjured.

Mr. Smith has observed, that in some instances the two fragments become interlocked or dovetailed as it were into one another, in consequence of the line of fracture being irregular and dentated.

The *signs of an intracapsular* fracture of the neck of the femur are alteration in the shape of the hip, crepitus and pain at the seat of injury, inability to move the limb, with shortening and eversion of it. These we must consider separately, as important modifications of each are sometimes noticed.

The *alteration in the shape* of the hip is evidenced by some flattening of the part, the trochanter not being so prominent as usual. This process is also approximated to the anterior superior spine of the ilium, and on rotating, the limb is felt to move to and fro under the hand, not describing the segment of a circle so distinctly as on the sound side. The circle described by the trochanter on the injured side is much smaller than that on the sound side. In the sound limb, the trochanter describes the segment of a circle having a radius equal to the length of the head and neck of the bone. On the injured side, the circle has only a radius equal to the length of that portion of the neck that still remains attached to the shaft of the bone. During this examination crepitus will usually be felt, though this occasionally is very indistinct and even absent, more especially if the limb be not well drawn down at the time it is rotated, so as to bring the fractured surfaces in apposition; and much pain is experienced by the patient on any movement of, or pressure upon, the joint.

Fig. 94.



The *attitude* of the limb is so peculiar, as in general to indicate at once to the surgeon what has happened. There is an appearance of helplessness about it that is striking. As the patient is lying on his back in bed it is everted, shortened somewhat, with the knee semi-flexed (fig. 94); on requesting him to lift it up, he makes ineffectual attempts to do so, and at last ends by raising it with the toe of the opposite foot, or with his hands. On being taken out of bed and placed upright, the injured limb hangs uselessly, with the toes pointing downwards, and the heel raised and pointing to the inner ankle of the sound side, the patient being unable to rest upon it. In some cases, however, it happens that after the fracture has occurred, the patient can

lift the limb somewhat, but with much exertion, from the couch on which he is lying; or can even manage to walk a few paces, or to stand for a few minutes upon it, with much pain and difficulty. This is owing either to the cervical reflexion of the capsule being untorn, or else to the fragments not being separated, having become locked into one another; and it usually occurs in those cases in which the other and more characteristic signs of this fracture are not well marked.

Eversion of the limb is almost an invariable accompaniment of this fracture. It is most marked in those cases in which the shortening is most considerable. This eversion has usually been attributed to the action of the external rotator muscles that are inserted into the upper end of the lower fragment. But I cannot consider this as the only, or, indeed, the principal cause, of this position; for, not only is it very difficult to understand how these muscles can rotate outwards the limb after their centre of motion has been destroyed by the fracture of the neck of the femur, their action being rather in a direction backwards than rotatory under these circumstances, but we find that the limb falls into an everted position in those cases in which the fracture being in the shaft, and altogether below the insertions of these muscles, no influence can be exercised by them on the lower fragment. I look upon eversion in cases of fractured thigh as not a muscular action at all, but as being simply the natural attitude into which the limb falls when left to itself. Even in the sound state, eversion takes place spontaneously whenever muscular action is relaxed, as during sleep, in paralysis, or in the dead body; and in the injured limb in which there is, as it were, a suspension of muscular action, it will occur equally. Indeed, the shortening that takes place will specially tend to relax the external rotators, and thus still more prevent their influencing the position of the limb.

Inversion of the foot in cases of intracapsular fracture has been noticed in a few cases. I have seen one instance of this; Smith, Stanley, and other surgeons, also record cases. The cause of this deviation from the usual symptoms of this injury has been a good deal discussed. It has been attributed by some to the cervical ligament not having been torn through at its inner side, but that, as Stanley observes, may prevent eversion, but cannot occasion inversion; by others, to the fact of the lower fragment in these cases being always found in front of the upper one. This circumstance, which is much insisted on by Mr. Smith, appears to me to be rather the result than the cause of the inversion, for any rotation inwards of the lower fragment by the adductor muscles of the thigh would have a tendency to draw the upper end of this fragment to the anterior, or, in other words, the inner side of the upper one. I am rather disposed to think that this inversion is owing, in some cases at least, to the external rotators being paralyzed by the violence they receive from the injury that occasions the fracture, and that thus the adductors, acting without antagonists, draw the thigh and leg inwards. In the instance that fell under my observation, and in some of those that have been published, the fracture resulted from direct injury to the hip, and was not occasioned by the patient jarring his foot, or by any indirect violence operating at the end of the limb.

The *shortening* in cases of fracture within the capsule seldom exceeds, in the first instance, half an inch to an inch, depending on the extent of the separation between the fragments, and cannot, indeed, in the early periods of the fracture, very well exceed the width of the neck of the bone, as the capsule is usually not torn through. After the fracture has existed some time, the capsule of the joint may yield, allowing greater separation between the fragments, and then it may amount to two, or even two and a half inches. It not uncommonly happens that the shortening, which is at first but very slight, about half an inch, suddenly increases to an inch or more; this is accounted for on the supposition of the cervical ligament, which had at first not been completely

ruptured, at last giving way entirely; or, it may be owing to the fragments which were originally interlocked, becoming separated. It is in those cases in which there is but slight separation of the fragments, and consequently little shortening, that the other signs of fracture are not very strongly marked, and that the patient preserves some power over the movements of the limb.

The constitutional disturbance in intracapsular fracture of the neck of the femur in old people is often considerable, and the injury frequently terminates fatally, from the supervention of congestive pneumonia, an asthenic state of system, or sloughing of the nates from confinement to bed during treatment. Hence, this injury must always be considered as one of a very dangerous and not unfrequently fatal character.

The *treatment* of these fractures turns in a great measure upon the view that is taken of their mode of union, and on the constitutional condition of the patient. In some cases no union occurs, but the head of the bone remains in the acetabulum, being hollowed into a smooth, hard, cup-shaped cavity, in which the neck, which has become rounded off and polished, is received, and plays as in a socket.

The union of the intracapsular fracture of the neck of the femur takes place, however, in the great majority of cases, by fibrous tissue. This is owing to two causes. In the first place, to the circumstance that the fractured surfaces are not in apposition with one another, which I look upon as the most important; and, secondly, that the vascular supply sent to the head of the bone, consisting only of the blood that finds its way through the vessels of the ligamentum teres, is insufficient for the proper production of callus.

In some cases, however, bony union takes place. This can only happen when, in consequence of the cervical ligament being untorn, or the fracture being impacted, the surfaces are kept in some degree of apposition, and the vascular supply to the head of the bone is speedily augmented by the blood carried into it through the medium of the plastic matter that is deposited between the fragments: under no other circumstances is it probable that osseous union takes place in these fractures; hence the unfrequency of its occurrence, there being in all probability not more than eighteen or twenty cases on record as having thus terminated, in this country. When bony union has taken place, the head will usually be found to be somewhat twisted round, in such a way that it looks towards the lesser trochanter, owing to the eversion that has taken place in the lower fragment.

As these fractures do not unite by bone, unless the fragments are in good contact, it is useless to confine the patient to bed for any long period, if the signs, especially the amount of *shortening*, indicate considerable separation between the fragments, or if the patient be very aged and feeble. Under these circumstances, lengthened confinement to bed most commonly proves fatal by the depressing influence it exercises on the general health, by the intercurrence of visceral disease, or by the supervention of bed-sores. It is, therefore, a good plan to keep the patient in bed merely for two or three weeks, until the limb has become somewhat less painful, the knee being well supported upon pillows. After this time, a leather splint should be fitted to the hip, and the patient be got up upon crutches. There will be lameness during the remainder of life, but, with the aid of a stick and properly adjusted splint, but little inconvenience will be suffered.

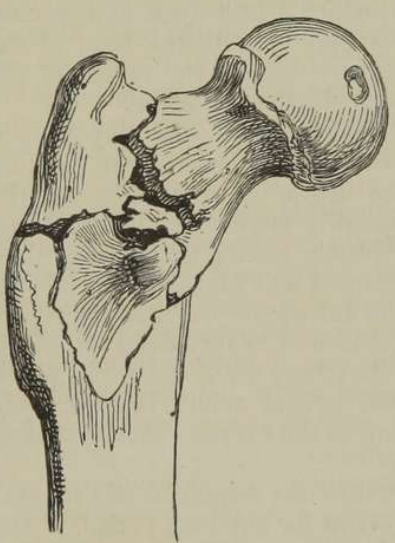
When the fragments do not appear to be much separated, there being but little shortening and indistinct crepitus, and more particularly if the patient be not very aged, but in other respects sound and well, an attempt may be made to procure osseous union. This may be done by the application of the long thigh splint, or, if this cannot very readily be borne, by the double inclined plane, with a padded belt strapped round the hips. This apparatus should be kept applied for at least two or three months, when a leather splint may

be put on, and the patient be got upon crutches. During the whole of the treatment, a generous and even stimulating diet should be ordered, and the patient kept on a water-bed or cushion. In these fractures of the neck of the femur, the starched bandage will often be found to be most useful. It may be applied as in fractured thigh, but should have additional strength in the spica part, and indeed may be provided with a small pasteboard cap, so as to give more efficient support. In old people, this plan of treatment is especially advantageous, as it enables them to sit up, or even to walk about, and thus prevents all the ill effects of long confinement to bed.

The *extracapsular fracture* of the neck of the femur is commonly met with at an earlier period of life than the injury which has just been described, being most frequent between the ages of thirty and forty. It is the result of the application of great and direct violence upon the hip, and occurs equally in both sexes.

This fracture may be of two kinds, the *simple* and the *impacted*. In both cases the neck of the bone is commonly broken at, or immediately outside, the insertion of the capsule of the joint. The fracture is almost invariably comminuted: indeed, I have never seen a case in which the great trochanter was not splintered into several fragments. In many instances the lesser trochanter is detached, and the upper end of the shaft injured (fig. 95). This splintering of the trochanter is owing to the same violence that breaks the bone, forcing the lower end of the neck into the cancellous structure of this process, and thus, by a wedge-like action, breaking it into fragments. When the neck continues locked in between these, we have the impacted form of fracture.

Fig. 95.



The *signs of extracapsular* fracture vary according as it is simple or impacted, but in both cases they partake of the general character of those that are met with in fractures within the capsule. The individual signs, however, differ considerably from these.

The hip will usually be found much bruised and swollen from extravasation of blood, which is usually considerable. The crepitus is very distinct and loud, being readily felt on laying the hand upon the trochanter, and moving the limb. The separate fragments into which the trochanter is splintered may occasionally be felt to be loose. The pain is very severe, and greatly increased by any attempt at moving the joint, which to the patient is impossible.

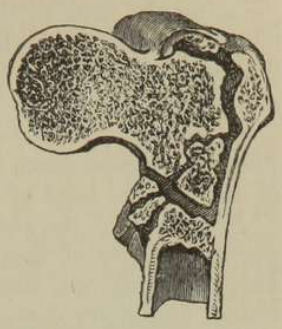
The *eversion* is usually strongly marked, and the position of the limb is characteristic of complete want of power in it. Inversion occurs more frequently in this fracture than in that within the capsule. Smith finds that of 7 cases of inversion of the limb in fractures of the neck of the femur, 5 occurred in the extracapsular fracture; and of 15 cases of extracapsular fracture, this condition was met with in three. When there is much comminution of the trochanter, the foot will commonly remain in any position in which it is placed, but generally has a tendency to rotate outwards.

The *shortening* of the limb is very considerable, being never less than from an inch and a quarter to two inches and a half, and often extending to three or four inches.

The *impacted extracapsular fracture* of the neck of the thigh bone occurs

when the upper fragment is driven into the cancellous structure of the lower one, remaining fixed there (fig. 96.) The signs of this form of fracture are often of a somewhat negative character, rendering its diagnosis and detection extremely difficult. In many cases there is pain about the hip, with slight eversion of the foot, and some shortening, usually amounting to about half an inch, but never exceeding one inch. There is but little crepitus; in some cases none can be detected, and the patient can frequently raise the foot for a few inches off the couch on which it is laid, and even walk upon it with a hobbling motion, though with much pain. In consequence of the impaction the limb cannot be restored by traction to its proper length, and consequently incurable lameness always results from this injury.

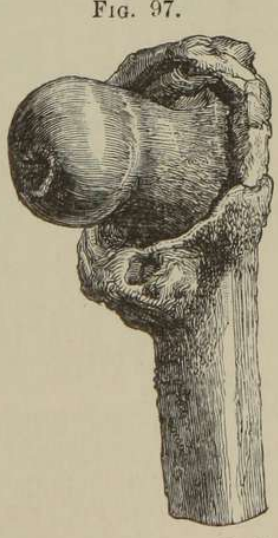
Fig. 96.



The *diagnosis* of the different forms of fracture of the neck of the thigh bone from one another, and from other injuries occurring in the vicinity of the hip joint, is a mattor of considerable importance, and often of no slight difficulty. Between the intracapsular and the ordinary extracapsular fractures there can be no difficulty; all the signs of the latter being so much more strongly marked than those of the former injury, the difference of age and the degree of violence required to break the bone being also important elements in the diagnosis. It is more difficult to distinguish between the intracapsular fracture and the impacted extracapsular fracture. In the former case, however, the crepitus and eversion are more marked, and the injury usually occurs from less direct violence than when the fracture is outside the capsule. In the latter case, also, traction cannot restore the limb to its proper length as in the former instance.

In severe contusions of the hip there is sometimes eversion of, and inability to move the limb, so that at first sight it might be supposed that the bone was broken. In these cases, however, the absence of shortening and crepitus will always establish the diagnosis. The difficulty is greater, however, in those instances in which the hip-joint having been the seat of chronic rheumatic inflammation, the limb is already somewhat shortened; here, however, the history of the case, and the fact of the shortening not being of recent occurrence, will be sufficient to establish the nature of the injury. The diagnosis of these injuries from dislocations will be considered in a subsequent chapter.

Fig. 97.



In the extracapsular fracture of the neck of the femur, death not uncommonly results from the severity of the injury, the pain and irritation of the fracture and the consequent shock to the system. The great extravasation of blood into the tissues of the limb has been known to be sufficient to account for the fatal result. When the patient lives, bony union takes place, large irregular stalactitic masses being commonly thrown out by the inferior fragment, so as to overlap the several splinters of bone. This callus is most abundant posteriorly in the inter-trochanteric space (fig. 97).

The *treatment* of the extracapsular fracture may very conveniently and efficiently be conducted by means of the long splint, a padded belt, if necessary, being strapped firmly round the hips underneath it; or the plan recommended by Sir A. Cooper of placing the patient on a double inclined plane, with both feet and ankles tied together, and a broad belt, well padded, firmly strapped round the body, so as to press the fragments of the

trochanter firmly against one another, will be found an excellent mode of keeping the limb of a proper length, and the fragments in contact.

Occasionally the fracture extends through the trochanter major without implicating the neck of the bone. Here there is shortening to about three-fourths of an inch, or an inch, with much eversion and crepitus readily felt. This fracture, which unites firmly and well by bone, must be treated in the same way as the last.

Compound fractures of the neck of the femur can only occur from bullet wounds. These cases require amputation at the hip-joint, unless the excision of the injured head of the bone be thought worthy of a trial.

Fractures of the shaft of the femur are of very common occurrence; every possible variety of this injury being met with here. They are usually oblique, except in children, when they are commonly transverse, and are often comminuted, double, or compound.

The *signs* are well marked. There is shortening usually to a considerable extent, with eversion of the limb, crepitus readily produced, and much swelling from the approximation of the attachments of the muscles. The lower fragment is always drawn to the inner side of the upper one, and rotated outwards; and when the fracture is high up there is a great tendency to angular deformity, in consequence of the projection outwards of the lower end of the upper fragment.

I have lately had an opportunity of ascertaining by dissection the condition of parts that leads to the eversion and projection forwards of the lower end of the upper fragment in fractures of the femur, in the case of an old man who died about three hours after meeting with a compound comminuted fracture of the middle and lower thirds of the right thigh-bone, and in whom this condition of the upper fragment was very distinctly marked. It was found that the gluteus maximus and medius could be divided without affecting the position of the bone; but when the gluteus minimus was cut across, it yielded somewhat. The pyriformis and external rotators were now felt to be excessively tense, and on cutting these across, the end of the fragment could at once be drawn inwards, all opposition ceasing. The projection forwards still remained, however, and this, which was evidently due to the tension of the psoas and iliacus muscles, yielded at once on dividing them. It would thus appear that there is a double displacement of the lower end of the upper fragments, — outwards, depending on the action of the external rotators, and forwards, owing to the contraction of the psoas and iliac muscles.

The *treatment* of fractures of the shaft of the thigh-bone may be conducted in four different ways; each of which presents advantages in particular forms of these injuries; hence an exclusive plan of treatment should not be adopted.

1st. The fracture may be treated by simply relaxing the muscles of the limb. This is effected by laying it upon its outer side, flexing the thigh well upon the abdomen and the leg upon the thigh, and supporting it in this position by an angular wooden or leather splint, extending from the hip to the knee, or outer ankle, and by a short inside thigh splint. This position I usually adopt in fractures about a couple of inches below the trochanters, in which there is a great tendency to the projection outwards of the lower end of the upper fragment, and find these cases turn out better in this way than by any other plan of treatment.

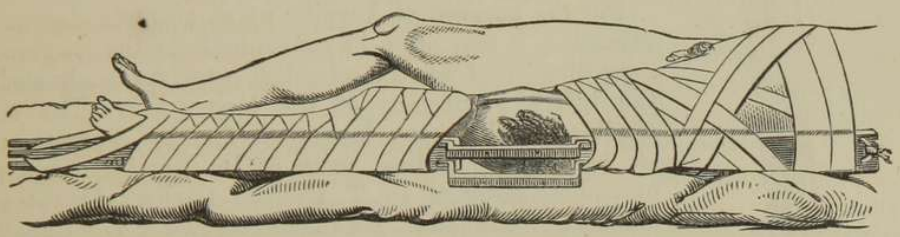
2d. Extension, without regard to muscular relaxation, by means of Liston's long splint and perineal band, will be found a most successful plan of treating fractures in the middle and lower part of the thigh.

In employing the long splint for the treatment of these fractures, care must be taken that it be of sufficient length to extend about six inches below the sole and nearly as high as the axilla. The perineal band should consist of a soft handkerchief covered with oiled silk, and must be gradually tightened. If

the perineal band occasion excoriation or undue pressure, so as to necessitate its removal, I have found advantage from keeping up extension with a heavy weight attached to the lower end of the splint.

In cases of compound fracture, where the fracture exists in the posterior and outer part of the limb, I have found a long thigh splint, made of oak and bracketed opposite the seat of injury, the most convenient apparatus, enabling the limb to be kept of a proper length, and the wound to be dressed at the same time (fig. 98).

Fig. 98.



3d. The double inclined plane is especially useful in many compound fractures of the thigh, often admitting of greater facilities for dressing the wound, and the general management of the case, than any other apparatus that can be applied.

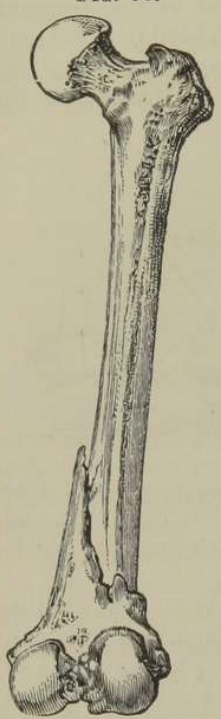
4th. The starched bandage may be employed in most cases. In treating fractures of the shaft of the femur with the starched bandage, the following plan will be found convenient. A dry roller should be applied to the whole of the limb evenly and neatly, which must then be covered with a thick layer of wadding; a long piece of strong pasteboard, about four inches wide, soaked in starch, must next be applied to the posterior part of the limb, from the nates to the heel. If the patient is very muscular, and the thigh large, this must be strengthened, especially at its upper part, by having slips of bandage pasted upon it. Two narrower strips of pasteboard are now placed along either side of the limb, from the hip to the ankle, and another shorter piece on the forepart of the thigh. A double layer of starched bandage should now be applied over the whole, with a strong and well-starched spica. It should be cut up and trimmed on the second or third day, and then reapplied in the usual way. With such an apparatus as this I have treated many fractured thighs, both in adults and children, without confinement to bed for more than three or four days, and without the slightest shortening or deformity being left (fig. 79). The points to be especially attended to, are, that the back pasteboard splint be very strong, at the upper part especially, and that the spica be well and firmly applied, so that the hip and whole of the pelvis be immovably fixed.

[In the treatment of fractures of the thigh, the majority of American surgeons prefer dressing the limb in the extended position, and for the most part make use of the apparatus of Desault, as modified by Dr. Physick. This is composed of two splints; an external one extending from near the axilla to beyond the foot, and an internal one reaching as high up as the perineum. Both splints should be enveloped in a splint cloth. The perineal or counter-extending band is made of muslin stuffed with cotton, and should be provided at its extremities with strong tapes, or, better still, with a strap and buckle. These should then be carried through mortices in the upper extremity of the long splint, and thus counter-extension may be obtained in a line nearly parallel with the long axis of the body. To prevent excoriation of the perineum, it is well to encase the counter-extending band in chamois leather.

Extension should be effected by the buckskin gaiter, by a handkerchief, or by means of two long stout strips of adhesive plaster. These should

be applied on either side of the limb in a longitudinal direction, and should reach from above the knee to beyond the sole of the foot; two or three circular adhesive bands will effectually prevent them from slipping. The remaining portions of the apparatus consist of compresses; of a short anterior splint, should there be any tilting upwards of the superior fragments; and of two junk-bags. These latter should be placed between the limb and the splints, and lateral pressure exerted by means of transverse tapes carried around the whole apparatus.

Fig. 99.



For the purpose of keeping up an accurate degree of extension, it may often be convenient for the surgeon to avail himself of some mechanical contrivance adjusted to the inferior extremity of the long splint. The most eligible of the many inventions for this purpose, are, we believe, the endless screw of Dr. Hamilton, and the extending screw of Dr. T. Hewson Bache. By the mechanism of the latter, the extending power is so applied as always to act in the line of the longitudinal axis of the limb.

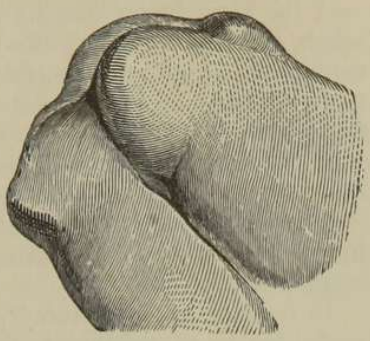
If the surgeon in the treatment of a fractured thigh, should desire to dress the limb on an inclined plane, the apparatus of Professor Nathan R. Smith, of Baltimore, will be found to answer the purpose admirably. It is light, portable, and when the limb is suspended, permits of a slight swinging motion. In fractures also of the bones of the leg, it frequently will fulfil every indication.]

Fractures in the vicinity of the knee-joint. — The lower end of the femur is not unfrequently broken in a transverse direction, both condyles being detached. This may occur in children from the lower epiphyses not being as yet solidly united to the shaft of the bone. In other cases again the fracture extends through one of the condyles, detaching it from the shaft of the bone. The readiness with which crepitus can be felt, and the line of fracture made out, determines at once the nature of this accident. These cases are sometimes complicated with wound of the knee-joint, rendering amputation necessary. They are best treated on the double inclined plane. I have lately had a case of impacted fracture in this situation under my care, the upper fragment, which was very oblique, being firmly driven into the cancellous structure of the lower one (fig. 99).

Fractures of the patella are most frequently met with in men, not very commonly occurring in women, and very rarely in children. I have, however, seen the patella broken in a child under ten years of age. They may be the result of direct violence, when the fracture is often comminuted, or the bone may be broken longitudinally, being split, and the joint injured. But most frequently they occur as the consequence of muscular action; the bone being torn across by the violent effort made by the extensor muscles of the thigh, in the attempt a person makes to save himself from falling when he suddenly slips backwards. All fractures of the patella from muscular action are transverse, the lower portion of the bone being fixed by the ligamentum patellæ; the upper segment is torn off by the spasmodic action of the extensors at the moment that the knee is bent, whilst the person is in the act of falling backwards. It not unfrequently happens when one patella has been fractured, that the unsteadiness of gait causes the opposite one to be broken by muscular action in an effort to save a fall. The same patella may be broken more than once; in those cases that I have seen, the second fracture has always occurred in the upper fragment, a little above the line of original fracture.

The *signs* of this fracture are very evident. When transverse, the separation between the fragments, which is much increased by bending the knee (fig. 100), and the inability to stand or to raise the injured limb, indicate what has happened; when longitudinal or comminuted, the crepitus and mobility of the fragments; and there is usually considerable swelling of the knee-joint in these cases, with perhaps wound of it.

Fig. 100.



When the bone is broken transversely, it very rarely indeed unites by osseous matter, in consequence of the wide separation of the fragments; there are, however, two or three cases on record in which this kind of union has taken place in these fractures. In the longitudinal and comminuted fractures, osseous union readily occurs, the fragments remaining in close apposition. In the majority of cases of transverse fracture, the fragments remain separated by an interval varying from one-fourth of an inch to an inch, but in some instances the gap is much greater, amounting even to four or five inches. When the separation does not exceed an inch and a half, the gap is usually filled up by fibrous or ligamentous tissue, uniting the fragments firmly. In some of the cases, however, in which the separation between the fragments does not exceed this distance, and in most of those in which it extends beyond it, Mr. W. Adams has found that the fracture is not united by any plastic matter that has been thrown out, but that the fragments are bound together simply by the thickened fascia which passes over the patella, with which is incorporated the bursa patellæ. Mr. Adams finds that the aponeurotic structure thus uniting the fragments may be arranged in different ways. Thus, it may pass between, and be adherent to the anterior periosteal surface of both fragments; or, the connecting aponeurosis may be reflected over, and be adherent to, both the fractured surfaces; or, lastly, and this is the most frequent form of arrangement, the connecting aponeurosis may pass from the periosteal surface of the upper fragment to the fractured surface of the lower one, to which it becomes closely and firmly united. In the majority of cases, when united by aponeurotic tissue, the fragments gape somewhat towards the skin, coming into better contact posteriorly. Thus, it would appear that a patella fractured transversely may unite in two ways; most frequently, by the intervention of thickened aponeurotic structure, and, next, by a ligamentous or fibrous band. Of 31 specimens in the London museums, examined by Mr. Adams, it was found that in 15 aponeurotic union had taken place, in 12 ligamentous union, and in the remaining 4 the kind of union could not be determined.

The aponeurotic union always leaves a weakened limb and an unprotected joint, for in consequence of the separation of the fragments, the folding in of the fascia, and its adhesion to the capsule of the joint, the fingers can be thrust in between the articular surfaces of the knee.

In the *treatment* of a fractured patella, the principal point to be attended to is, to keep the fragments in sufficiently close apposition for ligamentous union to take place between them. With this view, the upper fragment, which is movable, and has been retracted by the extensor muscles of the thigh, must be drawn down, so as to be approximated to the lower one, which is fixed by the ligamentum patellæ. This approximation of the fragments may be effected either by position and relaxation of the muscles, or by mechanical contrivance. By placing the patient in a semi-recumbent position, and elevating the leg considerably, so as to relax the muscles of the thigh completely, the upper fragment may be brought down to the lower one, and, if necessary, may be retained there, after any local inflammation that results from the accident has been sub-

dued, by moulding a gutta percha cap accurately to and fixing it firmly upon the knee, or by the application of pads of lint and broad straps of plaster. This position must be maintained for at least six weeks, at the expiration of which time the patient may be allowed to walk about, wearing, however, an elastic knee-cap, or, what is better, a straight leather splint in the ham, so as to prevent the knee being bent for at least three months. If this precaution be not taken, the union between the fragments, which at first appear to be in very close contact, will gradually lengthen, until in the course of a few months an interval of several inches may be found between them. In these cases, however, even though the separation between the fragments be great, it is remarkable how well the limb may be used, especially on level ground; and with the aid of a knee-cap but little inconvenience is experienced by the patient.

Compound and comminuted fractures of the patella, especially if occasioned by bullet-wounds, and injuring the knee-joint, are usually cases for immediate amputation.

In most cases of fractured patella the starched bandage will be found a very useful mode of treatment, the patient being with it enabled to walk about during the whole of the treatment. The action of the bandage is much increased, by drawing down and fixing the upper fragment by two broad strips of plaster firmly applied above it. A back splint of pasteboard is required to fix the knee, and a good pad of lint, with a figure of 8 bandage, should be applied above and below the fracture to keep it in position. In several cases I have obtained very close and firm union between the fragments in this way, without confining the patient to bed after the third day.

Fractures of the Leg.—The bones of the leg are frequently broken. The tibia, though a stronger bone than the fibula, is most frequently fractured, owing to its being more exposed and less protected by muscles, and receiving more directly all shocks communicated to the heel. The fractures of the upper part of this bone are usually transverse, and result from direct violence; those of the lower extremity, oblique, and proceed from indirect violence. When both bones are broken, the usual signs of fracture, such as shortening, increased mobility at the seat of injury, and crepitus, render the diagnosis easy; but when one bone alone is broken, it is not always a very simple matter to determine the existence of the fracture; the sound bone, acting as a splint, preventing displacement, and keeping the limb of a proper length and steady. If it be the tibia alone that has been broken, the fracture may be detected by running the finger along the subcutaneous edge, until it comes to a point that is somewhat irregular, puffy, or tender, where by accurate examination some mobility and slight crepitus may be detected. When the fibula alone is broken, the thick layer of the peroneal muscles, overlaying its upper two-thirds, renders the detection of the fracture difficult, but in the lower third it is easy, by attention to the same signs that occur in fractured tibia.

In the *treatment* of fractures of the leg, M'Intyre's splint will usually be found of great service during the earlier periods, more especially if there be much ecchymosis or extravasation, as it keeps the limb in an easy position, and admits of the ready application of evaporating lotions. After the swelling has subsided, the starch bandage should be applied, and the patient be allowed to move about on crutches. In some cases of fracture of the bones of the leg, however, M'Intyre's apparatus is not applicable. This is more particularly the case when the fracture is very oblique, from above downwards, and from before backwards; under these circumstances, the fragments cannot be got into good position so long as the limb is kept extended and resting on its posterior surface; the bones riding considerably, and one or other of the fractured ends pressing upon the skin in such a way as often to threaten ulceration. In these cases it is, that division of the tendo Achillis has been practised, with a view of removing the influence of muscular contraction. This appears to me, however,

to be an unnecessarily severe procedure, and certainly was not a very successful one in two cases in which I practised it; for although the tendon was exceedingly tense, but temporary benefit resulted, the displacement returning under the influence of the other muscles inserted into the foot. In these cases the bones may usually be got into excellent position by flexing the thigh well upon the abdomen, and the leg upon the thigh, so that the heel nearly touches the nates, and then laying the limb on its outer side on a wooden leg splint, provided with a proper foot-piece, and keeping it fixed in this position. In some cases the swing-box will be found a useful and very easy apparatus. In some fractures of the leg, the lower end of the upper fragment projects considerably, and cannot be got into proper position so long as the knee is kept bent; but if it be extended, so as to relax the extensors of the thigh, the bone is readily brought into good position. In fractures of the leg, however, as in all injuries of a similar kind, no one plan of treatment should be adopted exclusively, but the means had recourse to should be varied, and suited according to the peculiarities of each individual case.

Compound fractures of the leg are best treated on M'Intyre's splint, which admits of proper dressings being applied to the seat of injury more readily than any other apparatus. The details of the treatment of these injuries must be conducted in accordance with those general principles that were discussed in speaking of compound fractures.

In fractures of the leg, the starch bandage is especially applicable. It should be applied as follows. A dry roller having been put on to the limb, well covered with wadding, a strong pasteboard splint, four inches broad, and long enough to extend from the back of the knee to six or eight inches beyond the heel, should be applied to the back of the leg. The projecting terminal piece is now to be turned up along the sole of the foot, and two lateral strips adapted to either side of the limb. Over this the starch bandage, single or double, according to the size of the limb, must be tightly applied. After it is dry, about the end of the second day, it must be cut up as represented in Fig. 81, and re-adjusted, and the patient may then walk on crutches with perfect safety. In compound fractures of the leg, a trap may be cut in the bandage, as represented in Fig. 82, through which the wound can be dressed.

FRACTURES IN THE VICINITY OF THE ANKLE-JOINT are amongst the most common injuries of the bones of the lower extremity. They are usually occasioned by twists of the foot, by catching it in a hole whilst running, by jumping from a height to the ground, or off a carriage in rapid motion. These fractures are usually associated with severe strain, or even dislocation, of the ankle. The twist of the foot is almost invariably outwards, the sole remaining slightly turned in this direction, though not always to the extent that Dupuytren states, and the inner malleolus projecting under the skin; most commonly the toes are turned somewhat out, and the heel in.

Fractures of the lower ends of the Tibia and Fibula present four distinct varieties.

1st. The fibula may be broken at from two to three inches above the malleolus externus, the deltoid ligament being either stretched or torn.

2d. The fibula may be fractured about three inches above the ankle, the tip of the malleolus internus being splintered off as well. This constitutes the form of injury called "Pott's fracture," and is perhaps the most common fracture in this situation.

3d. The fibula may be fractured at about three inches above the ankle, and the lower end of the tibia at the same time be splintered off in an oblique direction from without, downwards and inwards (Fig. 101). And, lastly, the internal malleolus may alone be broken off, the fibula remaining sound, but one of the divisions of the external lateral ligament being torn through.

The signs of these fractures vary somewhat according to the bone that is

injured. When the fibula alone is broken, there is but slight displacement of the foot, but great pain and much swelling, with perhaps indistinct crepitus and irregularity of outline at the seat of fracture. If the tip of the inner malleolus is broken off as well, this may be ascertained by feeling the depression above the detached fragment. In those cases in which the lower end of the tibia is obliquely splintered, as well as the fibula broken, there are not only the ordinary signs of fracture, with eversion of the toes, and a corresponding turning inwards of the heel, and some rotation of the foot outwards, but the malleoli are widely separated, giving an appearance of great increase of breadth to the joint; crepitus is very readily felt, and a depression can be perceived corresponding to the line of fracture.

Fig. 101.

In these cases there is always a great deal of swelling from ecchymosis and inflammatory action, which requires to be subdued by the continuous application of cold before any apparatus can be applied. If there is not much displacement of the foot, the treatment may best be conducted by splints with good foot-pieces, and the starch bandage. If the foot be much twisted, Dupuytren's splint should be applied on the opposite side to that on which the twist of the foot has taken place, the pad being thickly folded at its lower end, and not descending below the ankle. Much stiffness is always felt after union has taken place, the ankle remaining weak and useless for a long time.

Compound Fractures of the ankle-joint are very serious injuries, commonly requiring amputation, if associated with dislocation and extensive wound of the soft parts. If, however, the wound be of but moderate extent, clean cut, and the tibial arteries uninjured, the fractures should be reduced, a portion of bone being perhaps sawn off in order to accomplish this, and the limb then placed upon a leg-splint with the foot well supported.

[Fig. 102.

]

Fractures of the foot almost invariably result from direct violence, and are usually accompanied by much bruising, and injury of the soft parts; hence there is usually but little displacement, and when the fracture is simple, rest and position alone are necessary. Compound fractures of the foot, attended by much bruising, often require partial removal of the part, or amputation of the leg.

The only special fractures of the foot requiring particular attention, are those of the calcaneum and the neck of the astragalus.

The *calcaneum* may be broken either by direct violence, as when a person jumping from a height alights forcibly on his heel, and thus fractures the bone; or else by the powerful action of the muscles of the calf tearing off a portion of the bone.

When the os calcis is broken through at its posterior part, beyond the insertion of the lateral ligaments, the detached fragment will be drawn up by the action of the strong muscles of the calf. But when the fracture occurs across the body of the bone, no displacement can take place, owing to

the lateral and interosseous ligaments keeping the posterior fragment in position, and preventing its being drawn away.

In the first form of fracture, the pain, swelling, flattening of the heel, and prominence of the malleoli, indicate the nature of the injury, even though crepitus be wanting. In the second variety, the mobility of the fragment, and its projection posteriorly by the muscles of the calf, point to the existence of the fracture, which is confirmed by the occurrence of crepitus.

In the *treatment* of these injuries, subduing inflammatory action, keeping the part fixed, by means of bandage and gutta-percha splints, with due attention to the relaxation of the muscles, is all that can be done. Union probably occurs by bone in some cases, though very commonly by fibrous tissue. [In fig. 102, the simplest treatment of fracture of the os calcis is represented, the leg being flexed upon the thigh, and the foot extended upon the leg, by means of a slipper, attached by a cord to a band encircling the lower part of the thigh.]

Fracture of the ribs and costal cartilages.—These injuries commonly arise from direct violence, the part that is struck being driven in towards the thoracic cavity, and thus broken. In other cases again the fracture occurs by indirect violence, the fore part of the chest being forcibly compressed, so that the rib is bent outwards, and thus snaps. When the injury is the result of direct violence, the pleura, lung, liver, or diaphragm, may be wounded, thus giving rise to the most serious and fatal consequences, such as hemorrhage, emphysema, and inflammation of the parts injured. When it is occasioned by indirect violence, the thoracic organs may be contused and thus injured, although, as the fracture takes place in a direction outwards, they are not under the circumstances liable to be punctured by the fragments. In some rare cases, the ribs have been known to be broken by the violent contraction of the abdominal muscles during parturient efforts.

Any one of the ribs may be broken, and frequently several are fractured at the same time. The middle true ribs are those that most frequently give way, being most exposed, and at the same time fixed. The first and second ribs are seldom broken, being protected by the clavicle and shoulder; when fractured, the injury is always a very dangerous one, on account of the importance of the subjacent structures. The lower ribs being less firmly fixed than the others, commonly escape, unless very great and direct violence be inflicted upon them. Any part of a rib may be broken by direct violence; but when the fracture is the result of compression of the chest, it is usually the convexity, or the neighborhood of the angle of the rib that gives way. These fractures most commonly occur in elderly people, in whom the elasticity of the thoracic parietes has lessened as the result of age.

Symptoms.—The chief symptom complained of is a sharp pricking and catching pain at the seat of injury, in breathing deeply, or in coughing. In order to avoid this, the inspirations are shallow, and the breathing principally abdominal. On laying the hand over the seat of injury, and desiring the patient to cough, a crepitus may often be felt; and in most cases this is audible on applying the ear to the chest. Occasionally the outline of the rib will be found to be irregular, and in some instances, where several ribs are broken, the whole side of the chest is flattened and depressed.

In treating fractured ribs, the surgeon need not concern himself so much about the union of the fracture, as about the prevention of pain to the patient in breathing, and the subsequent occurrence of serious inflammation or other mischief within the chest.

Any displacement that may exist usually remedies itself without the necessity of the surgeon interfering. If, however, a portion of the rib continues depressed, it had I think better be left so; the suggestions that have been made for elevating these fractures by means of sharp hooks and screw probes

being more likely, than the continuance of the depression, to occasion serious mischief to the contents of the thorax. In order to prevent undue motion of the broken bone, and consequent irritation produced by its puncturing the pleura or lung, the movements of the injured part of the chest may be restrained by the application of a broad flannel roller, or of a laced napkin round it. Instead of these means, I have for some years past found it more useful to apply a roll of adhesive plaster round the chest. The plaster must be about a foot in width, and should be sufficiently long to make one and a half turns round the body. It should be applied very tightly, and may be left on for ten days or a fortnight, when it may require re-application. It supports the chest more firmly and evenly than an ordinary bandage, affording the patient great comfort.

The prevention of inflammatory action must be attempted by the employment of bleeding, if necessary; but certainly by the adoption of a spare diet and complete rest. Any complication that may occur, such as emphysema, inflammation of the lungs or pleura, must be treated in accordance with the principles that will be laid down in speaking of injuries of the chest generally.

It occasionally happens that one or more of the costal cartilages, especially the fifth, sixth, seventh, or eighth, is broken by direct violence. This injury requires the same treatment as a fractured rib; the broken cartilage most commonly uniting by a bony callus which surrounds the fractured ends.

CHAPTER XVI.

INJURIES OF JOINTS.

JOINTS are often *contused* by kicks, falls, or blows, so as to be severely injured, with much pain, and consecutive inflammation of the capsule, synovial membrane, or other structures entering into their formation. The treatment should be actively antiphlogistic, with complete rest of the part. In a later stage, an elastic bandage, cold douches, and friction, are useful.

In some cases the *bursa*, situated in the neighborhood of a joint, is seriously bruised, and becomes inflamed in consequence; often giving rise to troublesome suppuration and some sloughing. When this takes place, free incision into the inflamed part, in addition to the ordinary antiphlogistic treatment, will afford speedy and effectual relief to the patient.

Sprains.—When a joint is twisted violently, so that its ligaments are either much stretched or partially torn, though there is no displacement of the osseous surfaces, it is said to be sprained. These injuries are exceedingly troublesome, and most frequently occur to the wrist and ankle joints. The pain attending them is very severe, and often of a sickening character, and the sprain is rapidly followed by swelling and inflammation of the joint and investing tissues, often of a very chronic and tedious character. As the inflammation subsides, stiffness and pain in using the part continue for a considerable length of time, which, in some cases, give way to a kind of rigidity and wasting of the limb. In others, again, a rheumatic tendency appears to be set up by injuries of this description, and occasionally it happens that in strumous subjects destructive disease of the joint is induced.

If the sprain is slight, rubbing the part with a stimulating embrocation, and giving the support of a bandage, is all that need be done. But if it be at all severe, more active measures must be had recourse to. The best mode of averting the inflammation, which is the thing to be dreaded in these cases, is to keep the part for several hours in cold water, or well moistened with an evaporating lotion, or wet by means of irrigation. Should this not check the inflammation, leeches should be freely applied, and when the swelling has somewhat subsided, the joint should be supported with an elastic roller or stocking, a starch bondage, or a leather splint, and be well douched with cold water twice a day, and afterwards rubbed or kneaded with soap liniment, until its usual strength and mobility are restored. This, however, very commonly does not occur in sprains of the knee and ankle for many weeks; a degree of stiffness, combined with inflammation, being left until the stretched and lacerated ligaments have regained their normal condition.

WOUNDS OF JOINTS.

A joint is known to be wounded when synovia escapes from the aperture, or when the interior of the articulation is exposed. If there is any doubt as to the wound penetrating the synovial membrane, no means, by probing or otherwise, should be taken to ascertain this, as in this way the very occurrence that is to be dreaded may be induced by the surgeon. The fact of the wound penetrating the joint will speedily be cleared up by the symptoms that supervene.

The severity of the wound of a joint depends chiefly on the size of the articulation, but partly on the nature of the wound.

When a small joint, as one of the fingers, is opened, the injury may often be recovered from, without destruction of the articulation. When a large joint is opened, even by a small incised or punctured wound, there is great danger lest such extensive local mischief and constitutional disturbance ensue as to lead to the destruction of the articulation, with loss of the patient's life. When the wound is large, lacerated, or contused, with fracture of the articular ends of the bones, one or other of these consequences certainly results. It is especially in grown-up persons that these unfavorable consequences ensue; in children, extensive injuries of large joints may heal favorably, though, if the child be of a strumous habit of body, destructive action is apt to be set up.

The source of danger in a wounded joint is the inflammation set up in the articulation (*traumatic arthritis*). A few hours after the infliction of the injury the joint swells, becomes hot, painful, and throbs. The pain increases, becoming tensive and excessively severe. If the aperture be large, synovia freely escapes, which soon becomes mixed with pus. If it be small, but little more than a puncture, the joint swells and fills with purulent fluid, which will either escape through the original wound or find an outlet for itself through a new situation. There are startings in the limb, with excessive pain in any attempt at moving it. The constitutional disturbance becomes very severe, the patient being occasionally carried off by the violence of the irritative fever. In other cases symptoms of purulent absorption come on, and death results from pyemia.

If the patient survive this period of acute action, abscesses will form around and above the articulation, the discharge from which, as well as from the joint, induces irritative fever and hectic. Should this danger be passed through, and the patient survive, it will be with a partially anchylosed limb, the utility of which is greatly impaired.

The severity of the symptoms in the wound of a large joint is evidently dependent on the extent and depth of the synovial membrane which suppurates, and to the pus thus formed being pent up in the midst of tense and unyielding tissues, from which it has not a free exit. It is the admission of air into the joint that occasions the suppuration, for we find that in the most extensive sub-

cutaneous wounds and lacerations of joints, as occur in dislocations and fractures, suppuration scarcely ever takes place. The presence also of the air appears to exercise an injurious influence upon the pus that is collected in the depths of the joint, causing it to become putrescent and acrid, and thus increasing the local irritation greatly. It is also this retention of acrid and putrescent pus, in contact with a large inflamed surface, that gives rise to ataxic fever and pyemia, that so frequently prove fatal in these injuries.

Traumatic arthritis differs from the destructive and disorganizing idiopathic inflammations of joints in this: that when the inflammation occurs as the result of a wound, the synovial membrane is the part primarily affected; if the cartilages become involved, they are so secondarily; the articular ends of the bones not participating in the morbid action. When a joint is the seat of disorganizing inflammation of an idiopathic character, the mischief usually commences in the osseous articular ends, or in the cartilage, the synovial membrane being often the last affected. In the traumatic form, the disease may be said to radiate from the centre of the joint; in the idiopathic, from the circumference.

In recent cases of traumatic arthritis we find the synovial membrane swollen, infiltrated, gelatinous-looking, and of a crimson color; the contiguous or subjacent portions of cartilage are softened and partially eroded. Under the microscope, a disruption of the cartilage cells may be observed, and the intervening substance is granular; these changes gradually cease in deeper sections of the cartilage, which will be found to present a healthy appearance. In the more advanced stages of the disease, when the joint has been suppurating perhaps for months, it will be found that the synovial membrane is deeply vascular in places, in other parts pulpy and infiltrated with, or replaced by grayish or yellowish plastic matter. The cartilages are eroded in patches, exposing the rough and injected surface of the articular extremity of the bone; where not eroded they are pulpy and disorganized. Occasionally partial but unsuccessful attempts at bony union will have been set up between the opposed exposed osseous surfaces.

In the *treatment* of wounded joints, the first point to be determined must be whether amputation should be performed, or an attempt made to save the injured limb. If the joint be small, there can be no doubt that we may attempt, and shall usually succeed in saving it. But if it be one of the larger articulations, the line of practice must be determined by the extent of the injury to the soft parts, and the constitution of the patient. If the wound be but small, and is clean cut, no surgeon would be justified in having recourse to immediate amputation, even though it be the knee that is injured. But if the joint is extensively laid open, with much contusion and laceration, perhaps dislocation, or fracture and splintering of the bones, the case is different. Under these unfavorable circumstances, however, in the upper extremity, and even in the ankle, the limb may not unfrequently be saved. If the bones be comminuted, the removal of splinters and partial resection of the articular ends, may advantageously be practised in many cases, more particularly if the patient's constitution be young and sound, and the soft parts not too extensively damaged. But if these be largely lacerated and widely contused, and the patient aged or broken in health, amputation is imperatively called for. This is more especially the case, when the knee is the articulation injured; extensive lacerations of this joint, more particularly complicated with dislocation or comminution of the bones, being cases for early amputation.

If it be determined to make an attempt at saving the limb, the principal point is, if possible, to close the wound by the first intention, and thus to prevent the occurrence of suppuration. If it be a puncture, or clean cut wound, this may occasionally be done by bringing its edges together and placing a piece of lint soaked in collodion upon it, or a strip of plaster washed over with resin varnish, the inflammatory action being subdued by continuous irrigation with cold water:

no poulticing or warm fomentations should ever be allowed during this stage. Union may take place under this dressing, but in the majority of cases the inflammation that is set up in the joint, causes so abundant a secretion of synovia, that it becomes loosened by the tension and outward pressure of the accumulated fluid which escapes from under it.

If suppuration have come on, free incisions, as recommended by Mr. Gay, should be made into the joint so as to procure an early outlet for the pus; the part must be well poulticed, and an attempt made at procuring anchylosis by the granulation and cohesion, through fibrous tissue, of the articular surfaces. By making free and early incisions into the joint after suppuration has once been sat up, the dangers resulting from decomposition of the pus and its absorption into the system are in a great measure lessened, and the constitutional irritation produced by the tension of the parts at once removed. The joint itself is not put into a worse condition by being more freely opened, for when one suppuration has been set up in it, even to a limited extent, destruction of its tissues must ensue; and the most favorable termination that can be expected is the production of anchylosis. At the same time constitutional treatment must be employed, with the view of lessening febrile action and removing irritation; the administration of antimonials, with calomel and opium, being especially serviceable; but free purging and all other sources of irritation should be avoided.

If the case proceed favorably the discharge will gradually lessen, and the constitutional disturbance subside. The joint must then be placed in such a position, that when anchylosis results, the limb may be most serviceable to the patient.

If, however, as very frequently happens when the larger joints are wounded, the suppuration within the articulation, and the abscesses that form outside it, reduce the patient to a hectic state, secondary amputation speedily becomes inevitable.

When the wound in the joint is too extensive for union by the first intention to be effected, and yet it be thought proper to make an effort to save the limb, the continued application of ice or of cold irrigation, and active antiphlogistic treatment, must be had recourse to, and free and early incisions to relieve tension and let out matter, so as to lessen the intensity of the suppurative inflammation that will be set up. In the great majority of these cases, however, where the larger joints, of the lower extremity especially, are implicated, amputation will eventually be required; the instances of recovery under these circumstances being altogether exceptional, the patient indeed not unfrequently sinking during the attempt at saving the limb.

DISLOCATIONS.

By a *dislocation* is meant the more or less complete displacement of the bony structures of a joint. In the orbicular joints, as the hip and shoulder, the osseous structures may be completely separated from one another, the dislocation then being *complete*. In the hinge joints, as the elbow and knee, the osseous surfaces commonly remain partially in contact, though displaced from their normal relations to one another; here the dislocation is *incomplete*. In most dislocations the integuments covering the displaced bones are put greatly on the stretch, but in some they are ruptured, and then the dislocation is *compound*. Besides these varieties, surgeons recognise *spontaneous* dislocations, in which the displacement does not occur from external violence. In other cases again, the dislocation arises from *congenital* malformation of the joint, in consequence of which the bones cannot remain in proper apposition.

Dislocations are predisposed to by various conditions, amongst which the arrangement of the joint appears to exercise most influence; orbicular joints being more liable to dislocation than any of the other articulations, whilst in

some of the synchondroses they never occur. Malgaigne finds, that of 491 cases of dislocation, 321 occurred in the shoulder, 34 in the hip, 33 in the clavicle, 26 in the elbow, 20 in the foot, besides others in the thumb, wrist, and jaw.

Dislocations are seldom met with in children, in whom fractures of the epiphyses more readily occur. Travers, however, has seen the hip dislocated in a boy five years of age. In old people the bones are so brittle, and the ligaments so tough, that violence causes fracture rather than dislocation. Hence it is principally in young and middle-aged subjects that dislocations are met with. They are necessarily more common in men than in women, from the nature of their respective occupations.

It is well known that it is rather owing to the continuous tension of the muscles, than to any arrangement of their osseous and ligamentous structures, that the articular ends of the bones of the extremities are kept in their proper positions, and that considerable external violence may be applied to a limb without dislocating it. If, however, the muscles be taken by surprise, or if they have been weakened by previous injury of any kind, the joint becomes predisposed to dislocation, and may be displaced under the influence of very slight causes. In this way the same joint may be repeatedly dislocated. Thus I have seen a man whose humerus had been dislocated between 40 and 50 times, owing to a weakened state of the deltoid.

The direct causes of dislocation are external violence and muscular action. The external violence may act either directly upon a joint, forcing or twisting the articular ends asunder, as happens when the foot is displaced by a twist of the ankle, or when the thumb is dislocated backwards by a blow. But more commonly the force acts at a distance from the joint that is displaced, and the head of the bone is thrown out of its socket by "the lever-like movement of the shaft," as happens when the head of the humerus is dislocated by a fall on the hand.

Muscular action alone may cause the dislocation of a bone, even though the part be previously in a sound state. Thus, the lower jaw has been dislocated by excessive gaping, and the humerus, by making a violent muscular effort. If the joint have already been weakened by previous injury or disease, muscular action is especially apt to occasion its displacement. The congenital dislocations, in all probability, arise from irregular muscular contractions in the fœtus by which the bones are displaced, and the normal development of the joint interfered with. In dislocations of the orbicular joints, after the head of the bone has been thrown out of its articular cavity, it is often still further displaced by the contraction of the muscles, which continues until they have shortened themselves to their full extent, or until the dislocated bone comes in contact with some osseous prominence that prevents its further retraction.

The existence of a dislocation is rendered evident by the change in the shape of the joint, and in the altered relation of the osseous prominences to one another; by the articular end of the displaced bone being felt in a new position, and by an alteration in the length of the limb, and in the direction of its axis. Besides this, there is after a time, if not immediately on the occurrence of the accident, impaired motion of, and pain in and around, the injured articulation.

The effects of dislocation on the structure of a joint are always of a serious character. The bones that enter into the formation of the articulation are not unfrequently fractured as well as displaced, more particularly in hinge joints; the cartilages may be injured, and the ligaments are always much stretched and more or less torn, the capsule of the joint suffering especially. In many cases the muscles and tendons in the immediate neighborhood are lacerated as well as displaced, and the vessels and nerves compressed. The skin is commonly stretched, and sometimes ruptured, when the dislocation becomes *compound*.

If the dislocation be a simple one, and if reduction be speedily effected, these injuries are soon repaired; and although a good deal of stiffness may continue about the joint, its functions are not usually permanently interfered with.

If the dislocation be left unreduced, important changes take place within and around the joint. Its cavity becomes filled up by a kind of fibrinous material, almost cartilaginous in structure. The ligaments are shortened and wasted, and a false joint forms around the articular end of the bone in its new situation. In some cases the bone upon which the dislocated head rests becomes depressed into a shallow cup-shaped cavity, so as to receive it. In others the depression is formed by the elevation of a rim of callus upon the subjacent bone, and in both instances the cellular tissue in the neighborhood becomes consolidated into a capsule of a fibroid character, surrounding and fixing the bone in its new situation, and usually admitting of but a limited degree of motion. The soft structures that have been lacerated at the time of the dislocation become matted together by plastic material, the muscles shorten, atrophy, and at last undergo fatty degeneration from disuse; the neighboring vessels and nerves may become attached to the new joint, or their sheaths become incorporated with the altered structures in contact with them.

In the *treatment* of dislocations, the first and principal indication consists in replacing the bone in its normal situation as speedily as possible. In doing this, the surgeon has two great difficulties to overcome: 1st, the contraction of the muscles of the part; and, 2nd, the anatomical structure of the joint.

The great obstacle to reduction is, the tonic contraction of the muscles inserted into or below the displaced bones; and in the reduction of the dislocation the surgeon's efforts are chiefly directed to overcome this contraction. The longer the dislocation is left unreduced the more powerful does this become, being less at the moment of the accident, and immediately afterwards, than at any subsequent period. Hence reduction should be attempted as soon as possible after the occurrence of the accident, and if the patient be seen at once, the bone may sometimes be replaced without much difficulty by the unaided efforts of the surgeon. Thus Liston reduced a dislocated hip by his own efforts immediately after the accident occurred. If a few hours have elapsed, the muscular tonicity becomes so great that special means must be adopted in order to diminish it; and if some weeks or months have been allowed to pass by, the dislocation may have become irreducible, partly owing to permanent contraction of the muscles which have been shortened by the approximation of their attachments, and which it is impossible to overcome, but chiefly, by the cohesion of the surrounding tissues, and the formation of adhesions about the head of the bone.

In the reduction of a recent dislocation, advantage may sometimes be taken of the occurrence of faintness, or of the patient's attention being distracted to other matters, in order to effect the return, the muscles being then taken by surprise, and the bone readily slipping into its place. Such measures as these, however, cannot be depended upon, and muscular relaxation should be induced by the administration of chloroform or ether. By the employment of these valuable agents, the muscles of the strongest man may be rendered perfectly flaccid and powerless in a few minutes, so as to oppose no action whatever to the reduction of the dislocation, which has thus been wonderfully simplified and facilitated. In no department indeed of practical surgery has the administration of anæsthetic agents been attended by more advantageous results than in this.

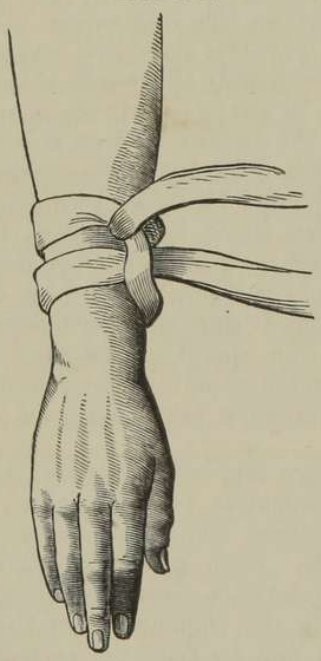
Mechanical contrivances are much less frequently had recourse to for the reduction of dislocation now than formerly. It is, however, occasionally necessary to employ apparatus calculated to fix the articular surface from which the bone has escaped, and to draw down the displaced bone to such an extent that it may be replaced on the surface on which it should be lodged. If the patient

have not been anæsthetized, it will be found that so soon as the bone is well brought down by the extending force so as to get opposite its articulation, being disentangled from osseous points upon which it may have hitched, it will be drawn at once into its proper position by the action of its own muscles, with a sudden and distinct snap; the muscles of the part being the most efficient agents in the reduction, so soon as the bone is placed in a position for them to act upon it. When, however, the patient has been placed under the influence of chloroform, the muscular system being thoroughly relaxed, the bone will not slip into its place with a snap or sudden jerk, but is reduced more quietly, and rather by the efforts of the surgeon than by any sudden contraction of its own muscles. It is important to note these differences in the mode of reduction, lest the surgeon, expecting to hear the snap or feel the jerk when chloroform has been fully administered, and, not doing so, should imagine the bone not to be reduced, and continue an improper degree of extension.

The purely mechanical means for the reduction of dislocation are sufficiently simple: the patient's body, and the articular cavity into which the luxated bone is to be replaced, are fixed by a split sheet, a jack-towel, a padded belt, or some such contrivance, by which *counter-extension* is practised. In some cases the hands of an assistant, or of the surgeon himself, or the pressure of his knee or heel constitute the best counter-extending means.

Extension may now be made either by the surgeon grasping the limb to be reduced and drawing it downwards, or else by means of a bandage or jack-towel fixed upon the part, with the clove-hitch knot applied in the way represented in the annexed cut (fig. 103). If more force be required, the multiplying pulleys (fig. 125), or the dislocation tourniquet invented by Mr. Bloxam (fig. 126), may be used, by which any amount of extending force that may be required can readily be set up and maintained. The "adjuster" invented by Dr. Jarvis is a useful and powerful instrument for the same purpose. These contrivances, however, are much less frequently required now than formerly, owing to surgeons taking advantage of the paralyzing effects of chloroform upon the muscular system, and consequently not requiring so much force to overcome their contractions. When any powerful extending force is applied, the skin of the part should always be protected from being chafed, by a few turns of a wet roller. The extension must be made slowly and gradually, without any jerking, equality of motion as well as force being attended to. In this way the contraction of the muscles is gradually overcome, whereas sudden and forcible extension might excite them to react against it. The traction is most advantageously made in the axis that the limb has acquired in its new position, without reference to its normal direction or to the situation of the joint. In this way the head of the bone is replaced by being made to pass along the same tract that it has torn for itself in being dislocated, and thus is replaced without the infliction of any additional violence to the tissues around the joint.

Fig. 103.



The question as to whether the extending force should be applied to the bone that is actually displaced, or to the further end of the limb, has been much discussed, and appears to have received more attention than it deserves. It is true that, by applying the extending force to the displaced bone itself, the

surgeon has greater command over its movements, with less chance of injury to the intervening bones; whilst, by applying the extending force to the lower part of the extremity, he has the advantage of a longer lever for the reduction of the head of the bone. This lever, however, it must be remembered, is in many cases a broken one, and cannot be made to act if the bone has to be replaced in the direction of the flexion of the joints that enter into its composition. For this reason, we find that some dislocations are best reduced by applying traction to the bone itself that is displaced, as in luxations of the femur and of the bone of the fore-arm; whilst, in other cases, as in the dislocations of the humerus, most advantage is gained by applying the extending force to the end of the limb.

But I look upon these points as of comparatively little consequence, believing that when the patient is not anæsthetized, the muscles of the limb themselves effect the reduction without the necessity of the surgeon employing any very powerful lever-like action of the bone; and that when the patient is paralyzed by chloroform, the bone is in most cases readily replaced by the simple movements impressed directly upon it, or even upon its articular end, by the hands of the surgeon.

In reducing a dislocation, it is of especial importance to attend to the relation of the osseous points in the neighborhood of the joint, and to disentangle the displaced bone from any of these upon which it may be lodged. This is especially the case in such hinge-joints as the jaw and elbow, in which the arrangement of the articulation is somewhat complicated.

After the dislocation has been reduced, the bone must be retained in position by proper splints and bandages, if necessary; the joint being kept quiet for two or three weeks, according to its size, so as to allow of proper union taking place in the capsule and neighboring structures. Any consecutive inflammation may often be prevented by the continuous application of cold; and, if set up, must be treated by local antiphlogistic means.

In dislocations of old standing, reduction is opposed not only by the powerful contraction of shortened muscles, and by a kind of rigid atrophy of the neighboring structures, but also by the existence of adhesions between the displaced bone and surrounding parts. If the dislocation have existed for several months, these obstacles will in general be sufficiently powerful to render it impossible to effect the reduction at all, or without the employment of such force as to occasion dangerous laceration of the tissues about the displaced bone, and serious inflammation of them; as happened in the cases related by Dr. Gibson, in which rupture of the axillary artery followed attempts at reducing old dislocations of the shoulder. If it be determined to attempt the reduction, the pulleys must be used, the patient being put under chloroform; but every precaution must be taken not to allow the traction to be carried to too great extent, lest sudden laceration of the parts occur.

The latest period at which reduction should be attempted, varies much according to the nature of the dislocation. It may be successfully practised at a much later period in luxations of the orbicular than of the hinge joints; and it is especially in the shoulder that these late attempts may be advantageously undertaken. According to Sir A. Cooper, however, the latest period at which reduction even in this articulation can generally be successfully effected, does not exceed three months and eight weeks for the hip; but within this time it may often be safely accomplished, Thus, Dupuytren reduced twenty-three cases of dislocated shoulder between the fifteenth and eighty-second day after the accident; and Breschet reduced the hip on the seventy-eighth day. At a considerably later period, however, than this, the luxated bone has been put into place. Thus Smith, of the United States, reduced one dislocation of the shoulder at the seventh month, and another at ten and a half months. In the reduction of some of these old-standing dislocations, it has been proposed to

divide by the subcutaneous section those muscles which appear to offer the greatest obstacle to the return of the bone. In this way Dieffenbach has succeeded in reducing a dislocation of the humerus two years after its occurrence. In some cases, however, as I have more than once witnessed, this plan does not succeed, owing evidently to the existence of contractions in, and adhesions between, other tissues than the muscular, and to the changes that have taken place in the articular surfaces, preventing the head of the bone being replaced or retained in its new position.

Compound dislocations are amongst the most serious injuries to which the limbs can be subjected. For not only is there such extensive laceration of the soft parts that cover and enter into the formation of the joint, as to give rise to the most severe forms of traumatic arthritis, but the bones are often fractured, and the main vessels of the limb perhaps greatly stretched or torn.

The *treatment* of a compound dislocation must be conducted on the same principles that guide the surgeon in the management of a wounded joint;—obtaining union if possible by the first intention, subduing inflammatory action, and letting out matter as it forms. Owing to the rupture of the ligaments and of the muscular attachments, there is usually no difficulty in the reduction, the bones being readily replaced; but the danger consists in the destructive inflammatory action that will be set up in the joint and limb, from the extensive injury inflicted upon them. This varies greatly, according to the size and situation of the joint, and the state of the soft parts. If it be small, as one of the phalangeal articulations, the dislocation may be reduced, and the parts covered with cold lint. If it be one of the larger joints, the line of practice will vary according to other circumstances than the mere dislocation. Thus, if it be in the upper extremity, the patient being healthy, and the soft parts not very extensively contused or torn, the bones may be replaced, cold irrigation assiduously applied, and antiphlogistic treatment pursued. If there be fracture conjoined with the dislocation, resection should be attempted, as was successfully practised by Hey in several cases of injury of the elbow of this description; but if the soft parts be greatly injured as well, and especially if the blood-vessels and nerves of the limb have suffered, amputation must be performed.

In the lower extremity, amputation is more frequently necessary; in the knee, almost invariably so. Sir A. Cooper states that he knows no accident that more imperatively demands amputation than compound dislocation of this joint. Yet there are exceptions to this rule; thus, Mr. White had a case of compound dislocation of the knee-joint in a boy, nine years of age, at the Westminster Hospital, in which he saved the limb by sawing off the condyles of the femur and reducing the bone. In the compound dislocations of the ankle and the astragalus, an attempt should generally be made to save the limb, in the way that will be more specially pointed out when we come to treat of these injuries.

After recovery from compound dislocations, the joint will remain permanently anchylosed; hence attention to position during the treatment is essentially required. In many cases, however, very good motion is ultimately obtained, though the stiffness may continue for some length of time.

The complication of *fracture of the shaft* of one of the long bones with dislocation of its head increases considerably the difficulty of reduction. Under these circumstances, it has been recommended to consolidate the fracture first, and then to attempt the reduction. But to do this is only to defer and increase the difficulties. At least seven or eight weeks would elapse before the fracture were sufficiently firmly united to bear the requisite traction to reduce so old a dislocation, and then there would be great chance of rupture of the callus, and certainly extreme difficulty in the reduction. It therefore appears to me much safer, under all circumstances, to reduce the dislocation at once, and afterwards to treat the fracture in the ordinary way. In reducing a dislocation complicated with fracture of the shaft of the displaced bone, the fracture must first be put

up very firmly indeed, with wooden splints completely encasing the limb. The patient must then be put fully under the influence of chloroform, which is of the most essential service in these cases, and when the muscles are completely relaxed, extension and counter-extension being made in the usual way, the reduction may be effected. The extending means should always be applied upon the splints, so that there may be no dragging upon the fracture. In this way I reduced last winter, without any difficulty, a dislocation of the head of the humerus into the axilla, complicated with comminuted fracture of the shaft of the bone, in a remarkably muscular man to whom I was called by Mr. Byam, and about the same time I had a case of dislocated elbow, with fracture of the shaft of the humerus, under my care at the Hospital, that was reduced with ease in the same way. After the bone has been reduced the fracture can be treated without difficulty.

When a simple fracture extends into the articular end of the bone, as in some dislocations about the elbow and ankle, there is no material increase in the danger of the case or in the difficulty of its management.

In compound dislocation with fracture of the articular ends, removal of splinters, partial resection or amputation will be required, according to the seat and extent of injury.

Spontaneous dislocations may occur either suddenly or gradually, according to the nature of the cause that gives rise to them.

In many cases they result from the destruction of the joint by old disease; the ligaments and cartilages being destroyed by suppuration, the head of the bone becomes carious and absorbed, and the articular surfaces are displaced by ordinary muscular action. This we commonly see in old cases of hip disease.

There, is, however, another and more rare form of spontaneous dislocation to which the hip and shoulder are liable, and which has been especially studied by Mr. Stanley. In these dislocations the head of the bone slips out of the articulation without any very marked sign of disease about the joint, and certainly without any previous destruction of it. In these cases there is either a paralytic condition of the capsular muscles, as has been observed several times in the shoulder, the deltoid having become paralyzed and thus allowed the bone to slip out of place; or, as has been noticed in the hip, obscure rheumatic or neuralgic pains have for some time been seated in the joint. The dislocation may not be confined to one joint, but may affect several. Thus some time ago there was a case in University College Hospital, in which both shoulders and hips were dislocated spontaneously. In many cases it occurs suddenly, and often without any pain to the patient, the deformity of the limb attracting attention to the accident, though in others it has been preceded by rheumatic affection of the joint. The treatment of these cases is not very satisfactory. Reduction in many cannot be accomplished, but in others it may be effected readily enough; though the bone cannot be fixed in the joint, out of which it slips again. In a case of spontaneous dislocation of the hip, without any apparent disease of the joint occurring, in a young woman who was placed under my care by Mr. Ashton, I readily effected reduction by the pulleys, three weeks after the occurrence of the displacement. The limb was then fixed with the long splint, and maintained at a proper length for two or three weeks; when, in consequence of a severe bronchitic attack, it became necessary to remove the apparatus, and the displacement speedily returned. Whilst convalescent from this attack she fell and fractured the displaced femur in its upper third, thus rendering it impossible to replace the bone again. In another case of spontaneous dislocation of the knee, occurring in the same painless manner, the joint could not be replaced, and permanent deformity was left. After reduction in similar cases, a splint or starched bandage should be worn for a considerable length of time, so as to give a chance for the ligaments of the joint to recover themselves. If there be a rheumatic tendency, that should be removed by

suitable treatment, and if there be a paralytic condition of the muscles, electricity, the endermic application of strychnine and cold douches with friction, may be advantageously employed.

Congenital dislocations are occasionally met with in the hip, shoulder, wrist, and jaw, and have of late years attracted the attention of surgeons through the labors of Guérin, Smith, Chelius, Robert, and others. These dislocations are closely allied in cause and nature with other congenital deformities of the limbs, such as club-foot, &c. In them there is usually found imperfect development of some portions of the osseous articular apparatus. Whether this is so originally, thus causing the displacement of the bones, or consecutive upon disuse, occasioned by spasmodic action of the one set of muscles or paralysis of another, dependent on some irritation in the nervous centres, is scarcely worth inquiring here. In some cases it would appear as if faulty position of the fœtus in utero, or undue violence during birth, may have occasioned the displacement. These dislocations are probably incurable, as there is always congenital defect of structure in the articular ends of the bones.

CHAPTER XVII.

SPECIAL DISLOCATIONS.

Dislocations of the lower jaw are of rare occurrence, and when met with are frequently occasioned by spasmodic action of its depressor muscles, — opening the mouth too widely, as in fits of laughing, of gaping, or in attempting to take too large a bite. Occasionally this accident has resulted from blows or kicks upon the chin, or from the violent strain upon the part in tooth-drawing. The mechanism of the dislocation is simple; when the mouth is opened the inter-articular fibro-cartilage with the condyle glides forwards on to the eminentia articularis. If this movement be continued too far, and the external pterygoid muscle contracts forcibly at the same time, the condyle slips forward into the zygomatic fossa, the coronoid process hitching against the malar bone, the axis of the ramus being directed obliquely backwards, and the dislocation being thus complete. In this way both condyles may be displaced, or only one.

The *signs* of this dislocation are evident from the nature of the accident. The mouth is widely opened and cannot be closed; deglutition and speech are impaired, the labial consonants not being pronounced; there is dribbling of saliva over the lower lip; the chin is lengthened, and the lower line of teeth advanced before those of the upper jaw; the cheeks are flattened, and there is a depression in front of the meatus externus. There is also an oblong prominence in the temporal fossa between the eye and the ear. If the dislocation is left unreduced, the patient slowly regains some power of movement over the jaw; he gradually approximates the lips, and, after a length of time, may even be enabled to bring the lines of teeth into apposition.

When one condyle only is dislocated, the axis of the lower jaw is directed towards the opposite side to that on which the displacement exists, and the general signs are the same, but in a less marked degree, as those that are met with when both sides are dislocated. The hollow before the meatus on the injured side is, however, well marked, and serves to point out the seat and nature of the displacement, the diagnosis of which is not always readily made; indeed, R. W. Smith states that he has seen attempts at reduction applied to the uninjured side.

Sir A. Cooper has described a *subluxation* of the jaw, which is most frequently met with in young and delicate women, in which the head of the bone appears to slip before the interarticular cartilage, so as to prevent the mouth being closed. Most commonly the natural efforts of the part are sufficient to return the head of the bone into the glenoid cavity with a loud snap, or a cracking noise.

The *reduction* of a dislocated jaw is easily effected, it being only necessary to push the angle of the bone downwards and backwards, so as to disentangle the coronoid process from under the zygomatic arch, at the same time that the chin is raised by the surgeon's fingers, in order that the temporal and pterygoid muscles may draw the head of the bone into its proper position. The reduction is best effected by the surgeon standing before the patient and applying his thumbs, well protected with a thick napkin, to the molar teeth on either side, and thus depressing the angle of the jaw forcibly, at the same time that he raises the chin by means of his fingers spread out and placed underneath it. The bone is then returned into its place with so forcible a snap, that, unless care be taken, or the thumbs be well covered up, they may be severely bitten. When only one condyle is luxated, the efforts at reduction should be applied to the injured side only. In the cases of subluxation, Sir A. Cooper recommends a tonic plan of constitutional treatment, such as iron, valerian, and shower-baths; to this I have found the application of a series of blisters over the articulation a useful addition.

After the reduction the four-tailed bandage should be applied, as in cases of fracture of the jaw, and for several days the patient must not be allowed to talk, or to eat any solid food, lest the displacement return, which it always has a great tendency to do. Very old dislocations of this bone may in this way be reduced. Thus Stromeyer replaced one at the end of twenty-five, and Donovan one at the end of ninety days.

The *congenital* dislocation of the condyle of the lower jaw is a remarkable and rare condition, for an acquaintance with which we are chiefly indebted to Mr. Smith. In this condition there is a singular distortion of countenance. The osseous and muscular structures on the dislocated side are atrophied, the teeth of the upper jaw projected beyond those of the lower, contrary to what occurs in the accidental dislocations; the mouth can be closed, speech is perfect, and there is no dribbling of saliva. Congenital dislocation of both condyles has not yet been observed.

DISLOCATIONS OF THE CLAVICLE are rarely met with in comparison to the frequency of fractures of this bone, owing doubtless to the short and firm ligaments by which it is attached to the sternum and acromion, and to its usually receiving any force that is applied to it in a line that corresponds to its axis, thus causing it to be rather bent and broken than luxated.

Either the sternal or the acromial end of the clavicle may be dislocated, and the simultaneous displacement of both has even been observed.

The *sternal* end of the clavicle may be luxated in a direction forwards, backwards, or upwards, being thrown before, behind, or above the sternum.

In the dislocation *forwards*, the end of the bone can be felt in its new position, the point of the shoulder is approximated to the mesial line, and the depression above and below the clavicle are strongly defined. It is occasioned by blows upon the shoulder, by bending this part forcibly backwards, or by violence applied to the elbow whilst the arm is raised from the side.

This dislocation, which is amongst the most frequent to which the clavicle is subject, may readily be reduced by pushing the shoulder outwards and bending it backwards. The principal difficulty in the treatment consists in preventing the return of the displacement, owing to the shallowness of the articular surface upon which the clavicle lodges. With this view a pad and figure of 8 bandage must be firmly applied upon the displaced end of the bone.

The dislocation *upwards* is of extremely rare occurrence. The signs in the two recorded cases were so evident as not to lead to any difficulty in the diagnosis of the accident, the projection of the sternal end of the clavicle in its new situation being subcutaneous, and at once cognizable to the touch. In the treatment, a bandage and pad, with elevation of the elbow, brought the bone into good position.

The dislocation *backwards* is not of common occurrence, though, according to Nélaton, there are at least ten or a dozen cases on record. This luxation appears generally to have resulted from the point of the shoulder having been driven upwards, or by the hand being violently drawn forwards. It has also been observed to result from the direct pressure of the clavicle backwards, as by the kick of a horse, and has resulted as a secondary consequence of curvature of the spine.

The *signs* are those that usually attend a dislocated clavicle, shortening of the shoulder, and deformity about the upper part of the sternum; but, besides these, a special train of symptoms is occasioned, by the pressure of the displaced bone upon the trachea, œsophagus, and vessels of the neck; in consequence of which, so much congestion of the head, giving rise even to a semicomatose state with difficulty in breathing and swallowing, may result, as to require the removal of the end of the bone, as happened in a case related by Sir A. Cooper, in which the surgeon was obliged to saw off the dislocated end. In some cases the end of the bone is thrown upwards as well as backwards; in others it takes rather a downward direction. In the treatment of this dislocation, it is easy to effect the reduction of the bone by making a fulcrum of the fist in the axilla, and then bringing the elbow well to the side, at the same time that an assistant puts his knee between the patient's shoulders and bends them back; but it is difficult to retain it in proper position. With this view, the figure of 8 bandage tightly applied to the points of the shoulders, and crossed over a large pad placed in the middle of the back, will give the most efficient support to the part, the elbow being at the same time well fixed to the side and drawn back.

The dislocations of the *outer* end of the clavicle are more commonly met with than those just described. The most frequent accident of this description is that in which the bone is thrown upon the upper surface of the acromion or upon the anterior part of the spine of the scapula. In several cases of this accident which have of late years presented themselves at University College Hospital, there has been no difficulty whatever in the diagnosis; the prominence formed by the displaced bone, the narrowing of the distance from the mesial line to the point of the shoulder, the facility of the reduction of the dislocation, and the tension of the clavicular portion of the trapezius muscle, indicate the nature of the accident. The treatment may in general be successfully conducted on the same principles as those on which a fractured clavicle is managed. In some cases, however, the dislocation has a tendency to return. Under these circumstances, M. Laugier has found that Petit's tourniquet strapped from the shoulder to the elbow, and properly tightened, keeps the bone in good position.

The outer end of the clavicle has been dislocated under the acromion by the application of direct violence to the end of the bone. This form of displacement is so rare that Nélaton states that there are only three cases on record; several instances have, however, of late been mentioned in the journals. The diagnosis must be easy, simple digital examination pointing out the nature of the accident, and the treatment must be conducted in the same way as that of fractured clavicle.

The acromial end of the clavicle has been known to be displaced underneath the coracoid process. Here also simple examination and the clavicular bandage suffice for diagnosis and treatment. The only instance of simultaneous dislocation of both ends of the clavicle that I am acquainted with, has been reported by Richerand.

DISLOCATIONS OF THE SHOULDER occur far more frequently than those of any other joint. Their pathology and treatment have been so clearly elucidated by Sir A. Cooper, that there is little left for subsequent writers but to follow the descriptions given by that great surgeon; though several of the modern French surgeons, especially Velpeau, Malgaigne, and Goyrand, have thrown some new light on the subject. The reason of the frequency of these dislocations is to be found in the shallowness of the glenoid cavity, the large size and rounded shape of the head of the humerus, and the weakness of the ligaments; but, above all, in the extent and force of the movements to which the joint is subjected. These displacements indeed would be much more frequent than they even are, were is not for the protection afforded to the joint by the osseous and ligamentous arch formed by the coracoid process and acromion with their ligaments, the great strength and close connection of the capsular muscles with the joint, and the support given by the tension of the long head of the biceps over its weakest part; but the principal obstacle to dislocation is the mobility of the scapula enabling all movements communicated to the hand and arm to react upon that bone.

The shoulder joint is susceptible of *four* dislocations. Of these, according to Sir A. Cooper, three are complete, and the fourth partial. I think, however, that on examination, it will be found that the so-called *partial* dislocation is in reality a complete one. The directions in which the head of the bone is thrown are *downwards and slightly inwards* under the glenoid cavity (fig. 104); *for-*

FIG. 104. FIG. 105. FIG. 106. FIG. 107.

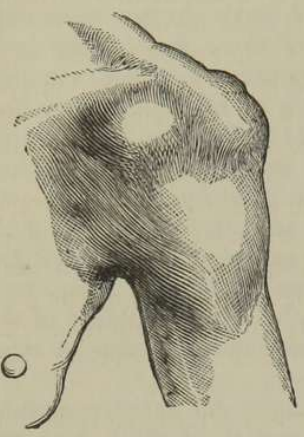
wards and inwards beneath the clavicle (fig. 105); *backwards and downwards* under the spine of the scapula (fig. 107); and *inwards and slightly downwards* beneath the coracoid process (fig. 106). Thus three dislocations are more or less inwards, only one being backwards or outwards.

In the dislocation *downwards*, or the *subglenoid* (fig. 104), the head of the bone lies in the axilla, resting against the inferior costa of the scapula below the glenoid cavity, and lodged between the subscapular muscle and the long portion of the triceps. This dislocation is the most frequent of all, and is an accident of extremely common occurrence. In it the axillary artery and plexus of nerves are compressed and stretched by the dislocated head of the bone; the tendon of the subscapular muscle is commonly torn near to its insertion to the lesser tubercle of the humerus, and the capsular ligament largely lacerated. The supra-spinatus muscle may also be torn through, or a portion of the great tubercle of the humerus detached, and the rest of the capsular muscles put greatly on the stretch.

In the dislocation *forwards*, or the *subclavicular* (fig. 105), the head of the bone is thrown on the inner side of the coracoid process, lying upon the second and third ribs under the pectoral muscles, and immediately below the

clavicle (fig. 108). In a case recorded by Mr. Curling, the infra-spinatus and subscapularis muscles were torn away from the tubercles of the humerus, and the teres minor partially lacerated, the capsule being completely separated from the neck of the bone, which pressed forcibly upon the axillary vessels and nerves. In two cases which I have had an opportunity of examining, the great tubercle was torn away from the head of the bone with much laceration of the capsule and extensive extravasation.

Fig. 108.



In the dislocation *backwards* or the *subspinous*, (fig. 107), the head of the humerus lies behind the glenoid cavity, and below the spine of the scapula, between the infra-spinatus and teres minor muscles. Mr. Key has found the tendon of the subscapularis torn across, together with the internal portion of the capsular ligament; the supra-spinatus and long head of the biceps being stretched, but not ruptured.

In the case of *incomplete* dislocation reported by Sir A. Cooper, the head of the bone was found to be thrown out of the glenoid cavity (fig. 106), lying under the coracoid process upon the anterior part of the neck of the scapula; the capsular muscles were not torn, but the long head of the biceps had been ruptured. The description given by Sir A. Cooper of this case, and reference to the illustrative plate in his work on "Dislocations," appear to point to a form of injury of the shoulder-joint which has of late years been specially described by the French surgeons as a variety of the dislocation downwards; that form of displacement, indeed, which by Boyer has been described as the dislocation "inwards," by Malgaigne the "subcoracoid" luxation, and by Velpeau as the "subpectoral" dislocation; in which the head of the humerus is placed in front of the neck of the scapula, and underneath the subscapular muscle. Why Sir A. Cooper described this as a *partial* dislocation, I do not understand; for not only was there rupture of the capsule and of the long tendon of the biceps, but the woodcut at page 401 of the last edition of his work shows clearly that the head of the bone had formed a new articular cavity for itself, in the subscapular fossa, being apparently completely thrown out of the glenoid cavity.

It appears to me that the only dislocation of the humerus to which the term *partial* is strictly applicable, is that which has been described by Mr. Soden, in which the long tendon of the biceps is displaced from its groove or ruptured, and the head of the bone thrown upwards and forwards under the coracoid process, but not out of the glenoid cavity. It is to this form of displacement, also, that Mr. Callaway seems disposed to confine the term *partial*.

Dislocations of the shoulder-joint are almost invariably the result of falls upon the hand or elbow, the particular variety of dislocation depending upon the direction of the shock communicated to the arm and the position of the limb at the time of receiving it. On this account we almost invariably find the displacements in a direction inwards and downwards. When a person saves himself in falling with his arms widely stretched out, the head of the bone is driven with all the force of a long lever against the lower and inner portion of the capsule, which being ruptured in this its weakest part, allows the bone to be thrown upon or to the inside of the inferior costa of the scapula, and thus into the axilla. When the patient falls upon his elbow, the inner part of the joint is still acted on, but the leverage not being so great, the head of the bone is thrown upwards or forwards under the clavicle. This dislocation is also often the result of direct violence applied to the shoulder.

The dislocation backwards can only take place when the arm happens to

receive the shock at the time that it is stretched across the chest. As this is an unusual position for any injury to be received in, this dislocation is proportion ately rare. An obstacle to this displacement may also be found in the great strength of the outer portion of the capsule of the joint as compared with the inner.

Amongst these various dislocations those into the axilla are by far the most frequent, and that under the clavicle next. The displacement of the head of the bone under the spine of the scapula is so rare, that Sir A. Cooper only met with two cases of it; two cases have occurred at the University College Hospital; both were reduced without difficulty.

The *signs* of dislocation of the humerus are sufficiently obvious, varying, however, according to the nature of the injury. In all cases there are six common signs, viz., 1st, a flattening of the shoulder; 2d, a hollow under the acromion; 3d, an apparent projection of this process; 4th, the presence of the head of the bone in the abnormal situation; 5th, rigidity; and 6th, pain about the shoulder.

In the dislocation *downwards — subglenoid* (Fig. 104) the head of the bone can usually readily be felt in the axilla, at its anterior and under part; the arm is lengthened to the extent of about an inch, the forearm is usually somewhat bent, and the fingers often numbed, in consequence of the pressure of the head of the bone on the axillary plexus. The elbow is separated from the trunk and carried somewhat backwards, but can be approximated to the side. If the head of the bone cannot be felt in the axilla, its presence then may be ascertained, as Cooper directs, by raising the elbow from the side, when it at once becomes perceptible.

In the dislocation *forwards — subclavicular* (Fig. 105) the head of the humerus can be felt and seen under the pectoral muscles beneath the clavicle; the arm is shortened, the axis of the limb being directed towards its head, and the elbow is a good deal separated from the side and thrown back.

In the dislocation *inwards — subcoracoid* (Fig. 106) there is less deformity about the shoulder than in the other luxations, the acromion not forming so distinct a projection. The limb is somewhat shortened, the elbow being carried backwards and slightly away from the side; the head of the bone is placed deeply in the upper and inner part of the axilla, and cannot be very distinctly felt, owing to its being thickly covered with soft parts, by the coraco-brachialis as well as by the pectoral; rotation of the arm and elevation of the elbow being usually required in order that it may be detected.

When the head of the bone is dislocated *below the spine* of the scapula (Fig. 107), it can be felt and seen there, more especially when the arm is rotated; the axis of the limb is likewise altered, being directed backwards.

In the *partial* dislocation the signs do not appear to be very evident. In Mr. Soden's case there was slight flattening of the outer and posterior parts of the joint, and the head of the bone appeared to be drawn higher up in the glenoid cavity than usual. There was great pain induced by any movement of the biceps muscle, and on attempting any overhand motions the head of the bone became locked by the acromion.

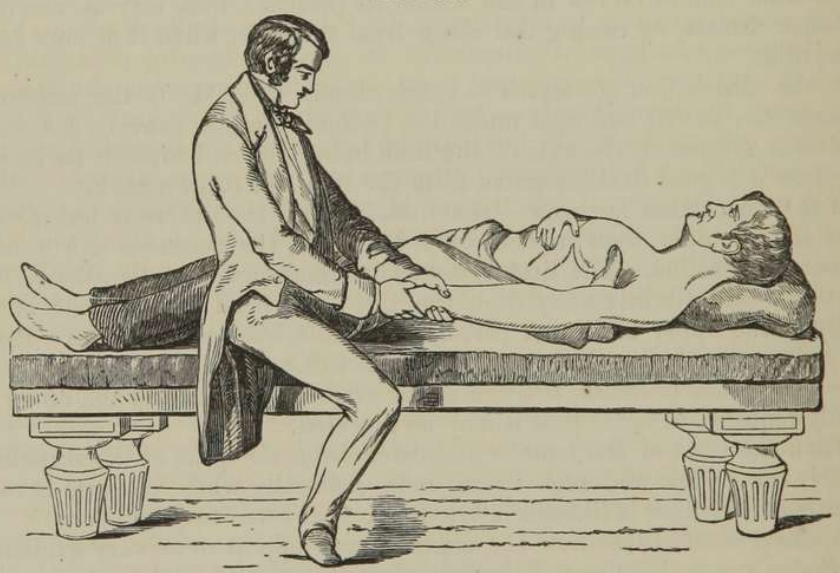
Dislocations of the humerus may readily be diagnosed from fractures of the anatomical and surgical neck of the bone, by the existence of the signs which are common to all luxations, and by the absence of crepitus. In fractures in this situation, also, the glenoid cavity always continues to be occupied by the head of the bone. The existence of crepitus, of slight shortening but little alteration in the axis of the limb, and no correspondence between this and the position of its head, are additional signs of value in establishing the diagnosis. Paralysis of the deltoid from a blow may simulate a dislocation, the shoulder being flattened and the acromion projecting; but here the mobility of the joint, and the

presence of the head of the bone in the glenoid cavity, establish the absence of dislocation.

The *reduction* of a dislocated humerus may be conducted on three different plans; — *by the heel in the axilla* — *by the knee*, or — *by drawing the arm upwards*. Whichever plan is adopted the patient should, if strong, be put under the influence of chloroform; when his muscles are paralyzed by this agent, but little force is required to effect the reduction, the surgeon's unaided strength usually sufficing for this purpose. If more power, however, should be required than he can exercise, extension may be made by assistants drawing upon a towel properly fixed round the lower end of the humerus, or else by the pullies attached to the same part of the limb.

1st. The reduction of the dislocation by the heel in the axilla is certainly the easiest procedure in ordinary cases. In adopting this plan, the patient is laid upon his back upon a low bed or couch; the surgeon seating himself upon the edge of this on the same side as the dislocated arm, takes the limb by the wrist, and fixing one foot firmly upon the ground, places the other, merely covered with the stocking, well up into the axilla, so that the heel may press against the lower border of the scapula, and the ball of the foot act upon the humerus (Fig. 109). He then draws the limb steadily downwards, and when it is disengaged to a sufficient extent, brings the hand across the patient, using his foot as a fulcrum, by which the head of the bone may be reduced by being

Fig. 109.



pushed upwards and outwards. This mode of reduction is especially serviceable in ordinary dislocations into the axilla, and in those under the clavicle. In the latter, however, it will be necessary to draw the arm more obliquely downwards and backwards, and to press the foot somewhat forwards upon the head of the bone, after it has been disengaged by being brought below the coracoid process.

2d. The reduction by the knee in the axilla is precisely the same in principle as the last, though not by any means so good a plan; the knee being too large and not following the movements of the humerus so readily as the foot. In effecting the reduction by this means, the patient should be seated on a chair, and the surgeon standing by his side, and resting one foot upon the seat, place his knee in the axilla. He then seizes the patient's arm above the elbow with his right hand, and steadying the acromion with his left, draws the limb well down; then bringing it across the knee the head of the bone is reduced.

3d. In some cases reduction is easily effected by laying the patient on his back, when the surgeon sitting behind him raises the arm perpendicularly by the side of the head, at the same time that he fixes the acromion. In this way the head of the bone is brought directly upwards into the glenoid cavity.

If the patient is very muscular, or the dislocation of old standing, it may be necessary to have recourse to the pullies in order to effect reduction. In applying these the scapula must be firmly fixed, the counter-extension being made by passing the patient's arm through a slit in the middle of a jack towel, which should be fixed firmly to a hook or staple in the wall. The extending force may then be applied immediately above the elbow; and traction being made slowly and steadily in the direction of the axis of the limb, the head of the bone should be directed to the glenoid cavity by the pressure of the surgeon's hands, so soon as it has come to a level with it. In this way dislocations of the humerus of many weeks, or even months' standing, have been successfully reduced; but in employing these powerful means, especially under the influence of chloroform, the surgeon should always bear in mind that unless care be taken, serious mischief, even laceration of the axillary artery, may result. After dislocation of the humerus has been reduced, the limb should be bandaged to the side and supported in a sling; and if inflammation occur about the joint, leeches and evaporating lotions may be had recourse to. In compound dislocations of the humerus, the bone must be reduced as speedily as possible, and the wound closed, the local inflammation being combated by irrigation and other appropriate means.

After reduction, there is a tendency for the head of the bone to be drawn upwards and outwards under and against the acromion, owing evidently to the deltoid and coraco-brachialis muscles not being any longer counterbalanced in their actions by those that have been separated from the head of the bone. *Compound* dislocation of the head of the humerus is a rare accident. I have known it occur in two directions, downwards and forwards. In it, even though the injury be extensive, it is better not to amputate if the brachial vessels and nerves be uninjured. The limb may then be saved by reducing the bone at once; after this the wound should be closed and dressed lightly, and kept cool by constant irrigation. If the axillary artery is ruptured, either completely or through its inner and middle coats, obstruction to the arterial circulation of the arm will ensue, and amputation must be performed through the articulation.

When the dislocation is complicated with a fracture of the shaft of the bone, it should be reduced at once by putting the fracture up very firmly, and then attempting the reduction by one of the usual methods. In the case to which I have already referred, p. 244, I succeeded without difficulty by means of the heel in the axilla. The fracture must then be treated by lateral splints.

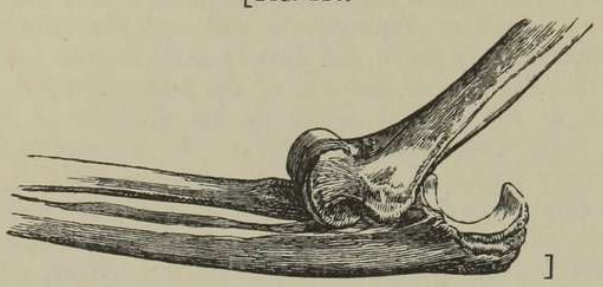
Congenital dislocations of the shoulder-joint have only of late years attracted attention. Mr. Smith has ascertained, by *post-mortem* examination, the existence of two varieties of this condition — the sub-coracoid and the sub-acromial luxations. In these there is wasting of the muscles of the shoulder and arm, the motions of which are extremely limited, whilst those of the scapula are preternaturally great. The condition of the bones is also remarkable. In a case of congenital subacromial luxation of both shoulders there was no trace of a glenoid cavity, but a well-formed socket existed on the outer side of the neck of the scapula, receiving the head of the humerus, which was small and distorted. These dislocations, though existing from birth, usually become more marked as age advances, but are necessarily irremediable in consequence of the malformation of the osseous structures and the wasting of the muscles.

Dislocations of the Elbow are by no means unfrequent accidents, and as they are often occasioned by direct violence, in consequence of which much swelling speedily sets in, their signs are frequently obscured, and the diagnosis rendered proportionately difficult; more especially when the dislocation happens

to be complicated with fracture of the articular ends of the bones. In these cases, indeed, it is only by a correct acquaintance with the normal relations of the osseous points, and by a comparison between those of opposite sides, that the surgeon can detect the true nature of the injury.

The varieties of dislocation of the elbow-joint are very numerous, either both bones of the forearm or only one being implicated. The most common dislocation is that in which both bones are thrown *backwards* (fig. 110), with or without fracture of the coronoid process. This injury is readily recognized by the projection backwards of the olecranon, carrying with it the tendon of the triceps. The articular end of the humerus also can be felt projecting in front of the elbow. When the coronoid process is not broken off, it is fixed against the posterior surface of the humerus, the forearm being immoveably placed in its new position. When this process is fractured there is great mobility about the joint, and crepitation may be felt as the arm is drawn forwards.

[Fig. 110.



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Dislocation of both bones *forwards* can scarcely occur without fracture of the olecranon. There are, however, cases on record in which the bones have been so displaced without this process being broken. In this injury the elongation of the forearm, the projection of the condyles of the humerus, and the depression of the posterior surface of this bone, render the diagnosis sufficiently easy. When the olecranon is broken off, there is elongation of the forearm and great mobility, but the detached fragment can be felt behind the humerus.

The *lateral* dislocation of the bones of the forearm is almost invariably incomplete; either the head of the radius hitching against the internal condyle, or the ulna coming in contact with the external one; complete lateral dislocation of the bones of the forearm being excessively rare. The only instance that I am acquainted with is a luxation outwards, reported by Nélaton, and of which he has given a woodcut.

The ulna or radius alone may be displaced, and, in some cases, both bones are dislocated, but in opposite directions, thus complicating considerably the nature of the accident.

The only dislocation to which the ulna alone is subject is that in a direction *backwards*. This seldom happens without more or less dislocation of the head of the radius. When it occurs it may be recognized by the projection of the olecranon backwards, and by the head of the radius being felt in its normal situation during the movements of pronation and supination. In the majority of cases the coronoid process would be fractured, at the same time causing ready disappearance and recurrence of the dislocation with crepitus.

The radius alone may be dislocated forwards, backwards, or outwards. The dislocation *forwards* is certainly the most common. In the many instances of it that I have seen, it has resulted from a fall on the palm of the hand, by which the lower end of the radius being driven backwards, the upper end is tilted forwards with the whole force of the leverage of the bone, and in this way, rupturing the annular ligament, is thrown against the external condyle. The signs of this displacement are the following: — The forearm is slightly flexed and in a mid state between pronation and supination; any attempt at the latter position occasions great pain, as does also the effort at straightening the arm. The elbow can only be bent at an obtuse angle, in consequence of the head of the radius resting against the lower end of the humerus (figs. 111, 113). On rotating the

radius much pain is experienced, and the head of the bone can be felt to roll on the fore part of the humerus, the external condyles of which project unnaturally. The hand and arm can be fully pronated, but cannot be supinated more than half way. The whole of the outer side of the arm is deformed, being carried somewhat upwards (Fig. 112). The rupture of the annular ligament in this dislocation makes it very difficult to keep the head of the radius properly fixed, so as to prevent a recurrence of the displacement. In some cases, and indeed not unfrequently, there is *incomplete* dislocation of the radius forwards, arising either from falls upon the hand, or from violent twists of the forearm In these we have the preceding signs, though to a less marked degree. The most characteristic symptom, however, is the inability on the part of the patient

Fig. 111.

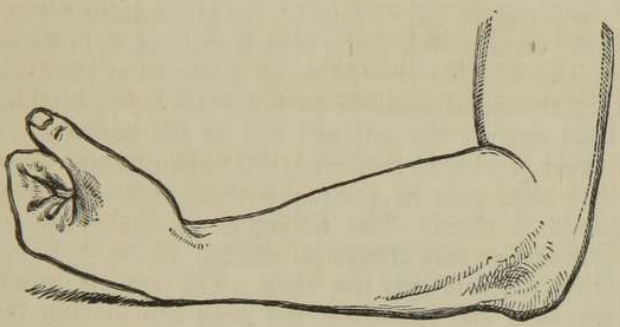


Fig. 112.

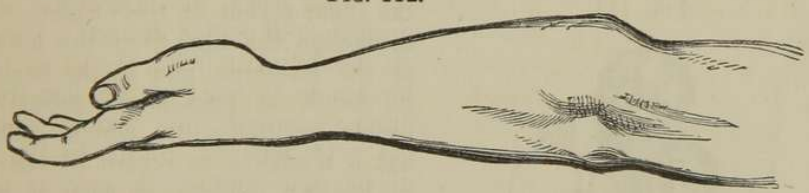
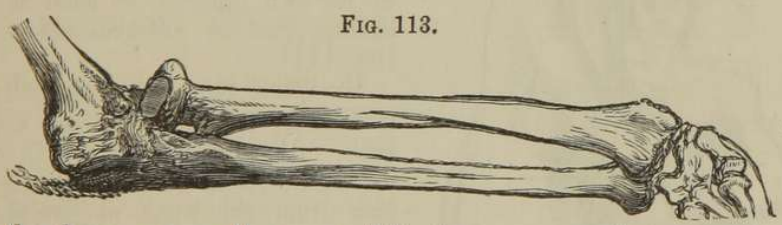


Fig. 113.



to flex the forearm upon the arm. This he can never do to a greater extent than to bring the elbow to a right angle (fig. 111). On being told to touch the tip of his shoulder with his forefinger, he will find it impossible to do so.

The dislocation of the radius *backwards* is of extremely rare occurrence; it may always be recognized by the head of that bone being felt subcutaneously behind the external condyle; the movements of the elbow, and of the radius especially, being at the same time very limited and painful. The dislocation of the radius *outwards* is of more frequent occurrence than the last form of injury, the head of the bone being thrown on the outer side of the external condyle, where it is felt under the skin, rolling as the hand is moved. The natural motions of the joint are of course greatly interfered with.

The radius and ulna are sometimes displaced in opposite directions, the ulna being thrown *backwards*, and the radius *forwards*. This injury, of which I have seen two instances at the Hospital, usually results from heavy falls upon the hand, with a wrench of the limb at the same time, as when a person is thrown out of a carriage, or lights upon his hands, in consequence of which the

bones are twisted and displaced in opposite directions. The deformity is of course great, but readily recognized by the combination of the characters of the two forms of displacement, provided an examination be made before the swelling has come on, which rapidly sets in.

Dislocations of the elbow-joint are very frequently complicated with fracture of one or other condyle of the humerus, of the olecranon, and, as we have already seen in displacement of the ulna, of the coronoid process. In these complicated injuries, an exact diagnosis is often extremely difficult, owing to the looseness and mobility of the parts, and to the great tumefaction that accompanies accidents of this description. It is in these cases that a good knowledge of the relative bearing of the different osseous points, aided by a comparative examination of the opposite limb, will alone enable the surgeon to effect a proper diagnosis of the nature of the injury.

The mode of *reduction* in dislocations of the elbow-joint varies according as the ulna is displaced or not. When the ulna is dislocated, in whatever direction it may be thrown, and whether the radius be displaced at the same time or not, we shall find that the great obstacle to reduction is the hitching of the processes of that bone against the articular end of the humerus. If either the olecranon or coronoid process be fractured, this entanglement cannot take place, and the joint then slips into its position without difficulty, though it is very difficult to maintain it there. The reduction of the displaced ulna, when uncomplicated by fracture, may always be effected, as Sir A. Cooper has recommended, by bending the arm over the knee. The patient being seated on a chair, the surgeon rests one foot upon the seat, and placing the knee in the bend of the injured elbow, grasps the forearm with both hands; fixing the arm, he presses the knee firmly against the inner aspect of the forearm, so as to disengage the ulna from the lower end of the humerus, and at the same time he bends or pushes the fore-arm into proper position; into which, indeed, it has a tendency to return by the action of its own muscles, so soon as the opposing osseous surfaces are separated (fig. 114).

Fig. 114.

In dislocations of the radius, this movement across the knee is not necessary. All that is required is to fix the upper arm, and then employing extension from the wrist to straighten the arm well, when, by bending the elbow at right angles, the head of the radius may be pressed into a proper position.

After reduction has been effected, the limb should be firmly put up in lateral angular splints, the hand being kept semi-proned. If the radius has been displaced, a pad should be firmly applied over its head, so as to prevent a return of the displacement, which is very apt to occur when the orbicular ligament is torn. The inflammation which usually results must be combated by the free application of leeches and of evaporating lotions. When this has subsided, passive motion may be commenced, and frictions and douches had recourse to, so as to remove the stiffness that is apt to be left about the joint.

In those cases in which the dislocation is complicated with fracture of some part of the articular ends, and in which the diagnosis of the precise nature of the injury, owing to the swelling or other causes, has not been very clearly made out, the joint should be placed in as good a position as possible, by the process of traction, flexion, and moulding, so as to bring the osseous points into proper bearing with one another; the angular splints must then be applied, and local antiphlogistic treatment had recourse to. At the end of a month or five weeks, passive motion may be commenced, lest permanent rigidity come on, which is very apt to supervene. Compound dislocations of the elbow-joint require to be treated on the same principles on which compound fractures of this articulation are managed. Dislocations of both bones have been reduced some weeks after the occurrence of the accident, and of the radius alone at as late a period as two years after the displacement.

Dislocations of the Wrist are of rare occurrence, so much so that their existence has been denied by Dupuytren and other modern surgeons. Although there can be no doubt that fractures of the lower end of the radius, more especially of an impacted character, have often been mistaken for these displacements, yet there can be no question that they do occasionally, though rarely, occur. Any doubt that may formerly have existed upon this point, in consequence of the want of post-mortem examinations, has been recently cleared up by the dissections of cases that have been made by Marjolin and Voillermier. The observations of these surgeons, together with those previously made by Sir A. Cooper, tend to show that dislocation of *the hand* from *the carpus* may take place either *backwards or forwards* (fig. 115). In whichever direction the accident occurs, a prominent smooth convex swelling, corresponding to the first row of the carpal bones, is felt and seen opposite the wrist. There is some shortening of the forearm, and the styloid processes of the radius and ulna form a projection on the opposite side to that in which the carpal tumor is seen. The facility with which the deformity is removed, and the displacement reduced, together with the general laxity of the wrist-joint, enable the surgeon to diagnose the injury from impacted fracture of the radius. The existence of the convex swelling points out, that it is not a mere sprain of the wrist that has occurred.

Fig. 115.

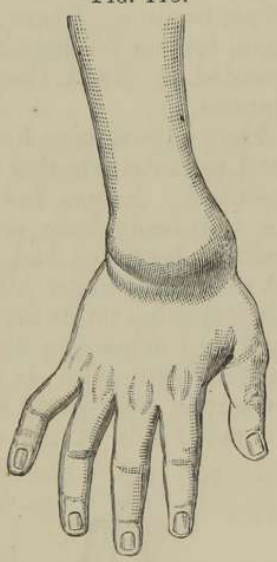
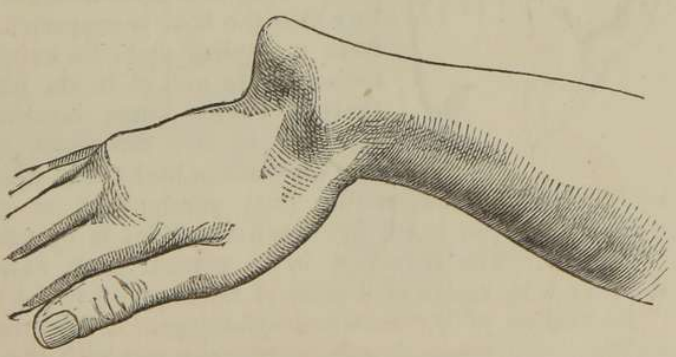


Fig. 116.



Besides these, another form of dislocation of the wrist may occur, in which the hand and the carpus are thrown forwards under the radius and ulna. This displacement, which has not, I believe, been previously observed, is illustrated in the accompanying figure taken from a cast sent to me by my friend Mr. Cadge (fig. 116). In it the projection of the styloid process of the ulna and the lower end of the

radius forming a slightly concave line, contrasts strongly with the convex swelling observed in the dislocation of the hand from the carpus (fig. 115).

The *treatment* of these cases is simple: reduction, which is readily effected, must be maintained by the application of antero-posterior splints.

Congenital Dislocations of the Wrist may take place either forwards or backwards. The limb is in either case greatly deformed. The bones are shortened, and altered in shape, more especially the lower end of the radius. The muscles are also shortened, the extensor tendons forming a sharp angle as they pass over the carpus.

Dislocations of single Bones of the Carpus are by no means of frequent occurrence. The bone that is most commonly displaced is the *os magnum*. This accident usually happens from falls, in which the hand is violently bent forwards, in consequence of which this bone starts out from its articulation, projecting as a round hard tumor on the back of the wrist opposite to the metacarpal bone of the middle finger. It may be readily reduced by being pressed upon at the same time that the hand is extended, thus pushing it into proper position. There is, however, a great tendency for this bone to slip out again, leaving considerable weakness of the joint, so much so that in two cases recorded by Sir A. Cooper, the patients found it necessary to wear artificial supports.

The *pisiform* bone has been observed to be displaced by Evans and Fergusson, but I am not aware that dislocation of any other of the carpal bones has been described. A case, however, lately occurred to me at the Hospital, in which the *semi-lunar* bone appeared to be dislocated. The patient in whom this accident happened had fallen from a height, injuring his spine, and doubling his right hand under him. On examining the wrist, a small hard tumor was felt projecting on its dorsal aspect, which readily disappeared on extending the hand and employing firm pressure, but started up again so soon as the wrist was forcibly flexed. It was evident that this bone belonged to the first row of the carpus, articulating with the radius, and from its size, its position towards the radial side of the carpus, and its shape, which could be very distinctly made out through the integuments, there could be little doubt that it was the semi-lunar bone.

Fig. 117.

The only *metacarpal bone* that admits of dislocation is that of the thumb; and though the articulation between this bone and the trapezium appears at first not to be of a character to resist much external violence, yet displacement of it seldom takes place. This is probably owing in a great measure to the powerful muscles by which the bone is supported in all cases in which the force is applied upon its palmar aspect, as it most frequently is, as well as to the little leverage offered by so short a bone. These luxations, however, have been observed in two directions, backwards and forwards. The dislocations backwards, which are the most common, are often compound, arising from powder-flask or gun-barrel explosions in the palm of the hand, by which the joint is opened, and the bone thrown backwards. The reduction is in general easy, extension being made from the thumb by means of a piece of tape applied round the first phalanx.

Dislocation of the *metacarpo-phalangeal* articulations are by no means of common occurrence, though occasionally met with (fig. 117). Most frequently the proximal phalanx of the thumb is the bone that is dislocated, being thrown *backwards* on the metacarpal bone. The signs of this accident are sufficiently evident, the prominence formed by the articular surfaces being distinctly marked. This dislocation of the proximal phalanx of the thumb has, owing to the difficulty of its reduction, attracted more attention than it would at first appear to

deserve. So great has this difficulty been in some cases as to render the dislocation irreducible, or to compel the surgeon to have recourse to operative interference in order to replace the head of the bone. The obstacle to the ready reduction of this small bone has been attributed to different causes. Thus, Hey supposed that it was owing to the constriction of the neck of the bone between the lateral ligaments of the joint; and Dupuytren entertained a very similar opinion, looking upon the position of these ligaments as the principal source of difficulty. The folding in of the anterior ligament of the joint and the interposition of a sesamoid bone between the articulating surfaces has also been looked upon as giving rise to this peculiarity.

The more probable explanation, however, appears to be that the neck of the metacarpal bone becomes locked between or constricted by the two terminal attachments of the short flexor of the thumb, which must be carried back over its head, together with the displaced phalanx. The observations of Vidal, Malgaigne, and Ballingall, point to this as the cause.

In many cases this dislocation may be reduced readily enough by the surgeon making extension with his fingers simply, and then pushing the bone into place; or, better still, after making some traction, by forcibly bending the phalanx towards the palm of the hand. If these means do not suffice, the hand should be fixed, and steady traction then be made from the phalanx, to which, previously protected by a strip of wet wash-leather, a piece of tape has been applied with a clove-hitch knot; or if more force be required, the pulleys may be used. In some cases the bone may be replaced by passing the ring of a door-key over the thumb, fixing one side against the projecting head of the phalanx, and then drawing and pressing this into its proper position. If all these means fail, subcutaneous section of the opposing muscle may be practised. If the dislocation be left unreduced, Sir A. Cooper says that the patient may still have a very useful thumb. In compound dislocation of this joint the bone may usually readily be replaced; should there be any difficulty its head must be removed, the dislocation being then reduced with great readiness, and the wound treated in a simple manner.

[A novel and exceedingly successful method for the reduction of this troublesome dislocation (fig. 118), has been practised by Dr. Crosby, of New Hampshire.

Fig. 118.

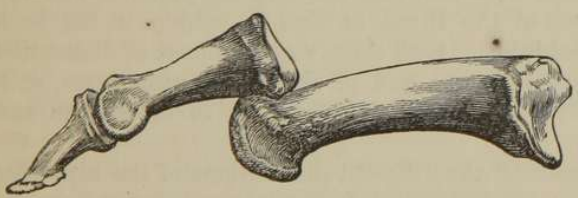


Fig. 119.

He directs that the surgeon, seated by the side of the patient, should press upwards and backwards the dislocated thumb, until the first phalanx assumes a position perpendicular to the metacarpal bone (Fig. 119). The base of the phalanx should then be pressed forwards by the thumb of the surgeon, when it will be found that flexion can easily be accomplished, and the joint restored to its natural position. Dr. Crosby states that in the great number of cases which have

occurred to him, he has never failed to effect reduction in a single instance. Vide *American Journal of the Med. Sciences, April*, 1858.]

Fig. 120.

Dislocation of the *phalanges* rarely occurs; when met with, these displacements are readily recognized by the deformity they entail (fig. 120), and as easily reduced by pressure and traction in proper directions. In compound dislocation of the phalanges, the bone should be replaced, the finger supported by a pasteboard splint, and the wound dressed lightly. In some cases it is necessary to remove the projecting end of bone before this can conveniently be done, anchylosis then results, a sufficiently useful finger being left.

Dislocations of the Hip. — Notwithstanding the great depth of the acetabulum, the complete manner in which the head of the thigh bone is received into its cavity, the firmness of the capsular ligament, and the great strength of the capsular muscles that surround and support the joint, dislocations of the hip are more frequently met with than those of many other joints that appear less perfectly supported. This is doubtless in a great measure owing to the great length of leverage of the femur acting upon its head, when external violence is applied to the knee, and of that of the whole length of the lower extremity when it is applied to the foot.

The different forms of dislocation of the femur have been expressed with great clearness and precision by Sir A. Cooper, who has shown that its head is most commonly thrown *upwards and somewhat backwards*, so as to lodge on the slightly concave surface between the acetabulum and the crista ilii, resting on the gluteus minimus, and having the trochanter turned forwards (fig. 121); or it may be thrown *downwards* into the foramen ovale lying upon the obturator externus muscle (fig. 123); or, *forwards and upwards* upon the horizontal branch of the pubes under the psoas and iliac muscles to the outer side of the femoral vessels (fig. 124). The head of the bone may also be thrown *backwards* into the sacro-sciatic notch, resting upon the pyriformis muscle (fig. 122). These are the four forms of dislocation of the hip, admitted by Sir A. Cooper, as of the more usual character; besides these, however, may be added, as not of very unfrequent occurrence, that form in which the bone is thrown backwards and somewhat downwards behind the tuberosity of the ischium. In addition to these, other less common forms of dislocation have been noticed; for instance, one in which the head of the bone lies between the anterior superior and the anterior inferior spinous processes of the ilium, or that in which it has been thrown upon the spine of the ischium. In all these various forms of dislocation there is rupture of the capsular ligament and of the ligamentum teres, with laceration of the muscles about the joint, and extravasation of blood into and around them.

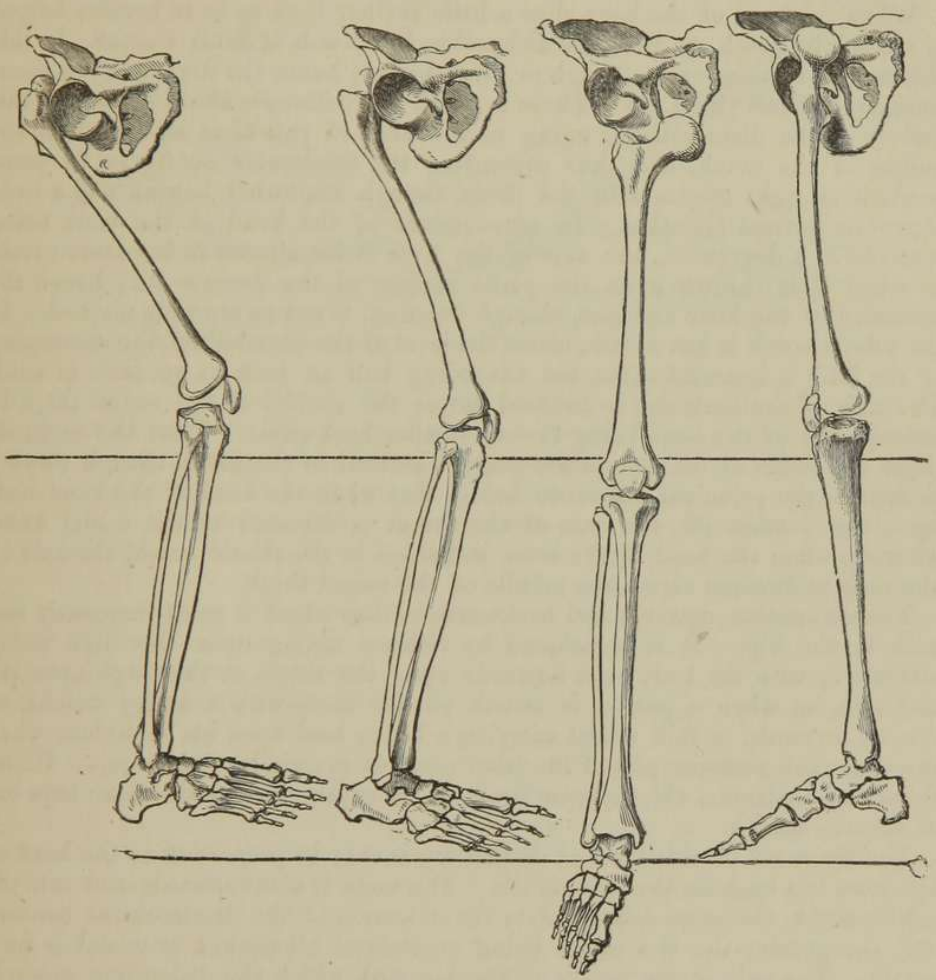
The signs, causes, and treatment of the different dislocations of the hip differ so greatly from one another that, practically, it becomes necessary to describe each of these displacements as a separate lesion. In considering these, we may reduce the more ordinary dislocations of the hip to four distinct varieties, besides which, however, it is necessary to bear in mind, that other and less usual forms of displacement may occur.

The most common dislocation is that in which the head of the bone is thrown *upwards and backwards* upon the dorsum of the ilium, or rather upon that portion of the bone which extends between the acetabulum and the sacro-sciatic notch (fig. 121). This displacement differs so slightly in its pathology and treatment from the dislocation into the sciatic notch (fig. 122), described as a distinct variety of the injury by Sir A. Cooper, that I think it is more consis-

tent with the true nature of these accidents to look upon them as essentially the same, the displacement in both cases being upwards and backwards, but in different instances partaking more of one or other direction. This dislocation may therefore be described as the *ilio-sciatic*.

The next distinct dislocation is that in which the head of the bone is thrown *downwards* upon the obturator foramen, hence termed the *thyroid* dislocation (fig. 123).

Fig. 121. Fig. 122. Fig. 123. Fig. 124.



The third variety is the *pubic*, where the head of the bone is thrown *upwards* upon the pubes (fig. 124); and lastly,

The *sciatic* dislocation, in which the bone is thrown *downwards and backwards* behind the tuberosity of the ischium.

Thus it will be seen that in whatever direction the displacement occurs, the head of the bone has a tendency to sink into some cavity or depression, or to lie upon one of the osseous surfaces in the neighborhood of the acetabulum.

In the dislocation *upwards and backwards* or the *ilio-sciatic*, if the head of the bone rest upon the dorsum of the ilium, the hip will be found to be a good deal distorted, the gluteal region being somewhat prominent, and the upper part of the thigh enlarged, in consequence of the approximation of the muscular attachments. The head of the bone can be felt in its new situation, more especially on rotating the limb; the trochanter is less prominent than natural, usually lying close against the brim of the acetabulum, and being turned

forwards; there is considerable shortening, varying from one and a half to three inches, and the position of the limb is remarkable, being distinctly rotated inwards, with the thigh slightly bent upon the abdomen, and the leg upon the thigh, so that the knee is semi-flexed, and raised from the surface on which the patient is lying. The foot is inverted, so that the ball of the great toe rests on the ankle of the sound limb, and the heel is somewhat raised. The axis of the thigh is directed towards the sound knee (fig. 121). The movements of the joint are greatly impaired; abduction and eversion are not practicable, but inversion, abduction, and some flexion upon the abdomen, can be practised.

When the head of the bone slips a little further back so as to become lodged in the sciatic notch, we have the dislocation backwards of Sir A. Cooper. In this the same symptoms exist, though to a less degree; hence the diagnosis is proportionately difficult (fig. 122). There is much less deformity about the hip in this variety of the displacement, owing to the head of the bone sinking into the hollow of the notch, and thus presenting the trochanter nearly in its usual position at right angles with the ilium, though somewhat behind and a little above its normal situation. In consequence of the head of the bone being received in a depression, the axis of the limb is not altered to the same extent as when it is thrown upon the plane surface of the dorsum ilii; hence the inversion of the knee and foot, though existing, is not so strongly marked. As the sciatic notch is but a little above the level of the acetabulum, the shortening of the limb is inconsiderable, not exceeding half an inch or an inch at most. The axis of the limb also is directed across the middle of the sound thigh in consequence of the bone being thrown further backwards. Thus the signs of these two forms of dislocation are nearly identical in character, though varying in degree, the principal difference being, that when the head of the bone rests upon the dorsum ilii, the axis of the femur is directed to the sound knee, whereas, when the head of the bone is lodged in the sciatic notch, the axis of the limb is directed across the middle of the sound thigh.

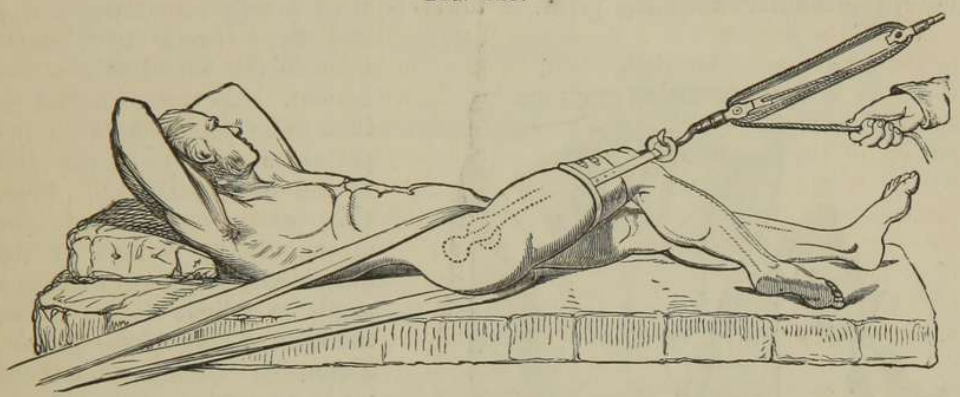
The dislocation upwards and backwards is that which is most frequently met with in the hip. It is occasioned by violence acting upon the limb whilst abducted; with the body bent forwards upon the thigh, or the thigh upon the abdomen, as when a person is struck on the back with a heavy weight, or thrown forwards, or falls whilst carrying a heavy load upon his shoulders, when the upper and posterior part of the joint receives the whole of the strain. Under these circumstances, the capsular ligament is ruptured, and the bone slips out of its articulation.

The diagnosis of this form of dislocation is easy in proportion as the head of the bone lies high on the dorsum ilii. The more it sinks towards and into the sciatic notch, the more difficult does the detection of the displacement become, and the greater the risk of its being overlooked altogether, or mistaken for a sprain. The only severe injury of the hip with which the dislocation upwards and backwards can be confounded, are those rare cases in which there is fracture of the neck of the femur, with inversion of the limb; here, however, the increased mobility, and the existence of crepitus, will enable the surgeon to effect the diagnosis. In ordinary cases of fracture of the neck, the existence of eversion of the limb at once points out that the head of the bone is not dislocated on the ilium.

The *reduction* of this form of dislocation is effected in the following manner. The patient having been put under the influence of chloroform, is laid on his back upon a strong table between two staples, one of which should be fixed to the floor, and another at a point above the level of the body, in a direct line with the axis of the limb, and about twelve feet apart. The counter-extending force, consisting of a jack towel or of a padded leather belt, must then be passed between the injured thigh and perineum, and fixed to the staple in the floor. The pulleys must now be attached to proper straps or to a towel fixed

with a clove-hitch knot immediately above the knee, by one end; the other extremity being attached to the staple in the wall, which should be so situated as to be continuous with the axis of the lower part of the limb. The knee being then slightly bent and rotated inwards, traction is applied slowly and steadily until the head of the bone has approached the acetabulum, when the surgeon rotates the limb inwards so that the head may slip into its socket (fig. 125). If difficulty occur in raising the bone over the acetabulum, the

Fig. 125.



plan recommended by Sir. A. Cooper, of passing a towel under the thigh to enable an assistant to lift the head of the bone over the brim of that cavity, may be had recourse to. The fact of the reduction being accomplished, is ascertained by comparing the bony points of the limb with those of the opposite side, and seeing if they correspond. A long splint and spica bandage should now be applied to fix the thigh, and the patient be kept in bed for a fortnight, so that reunion of the ruptured tissues may take place. In reducing this dislocation, there is some danger of the head of the bone slipping downwards into the sciatic notch, if the limb be too much raised. This accident, which has happened to some very excellent surgeons, may be mistaken for reduction of the bone, a serious mistake, that would, unless corrected, entail permanent lameness on the patient.

When the bone is thrown upon the sciatic notch, the reduction is difficult, and a slight modification of the treatment is required; this consists in laying the patient on his sound side instead of on his back, and making extension across the middle of the sound thigh instead of immediately above his knee, as in the last case. In the reduction of this dislocation, also, Sir A. Cooper gives the very valuable advice, of lifting the femur out of the notch and over the edge of the acetabulum by means of a round-towel placed under the upper part of the thigh and over the shoulders of an assistant, who at the same time should rest his limbs on the patient's pelvis, and then raising his head draw the bone towards its socket.

Reduction of dislocations on to the dorsum ilii or sciatic notch, may be effected readily enough whilst the patient is under chloroform, by "manipulation" of the limb, as introduced by Dr. Reid, of Rochester, U. S. This is done by flexing the leg on the thigh, carrying the dislocated thigh over the sound one, upwards across the pelvis, as high as the umbilicus, and then by abducting and rotating it outwards.

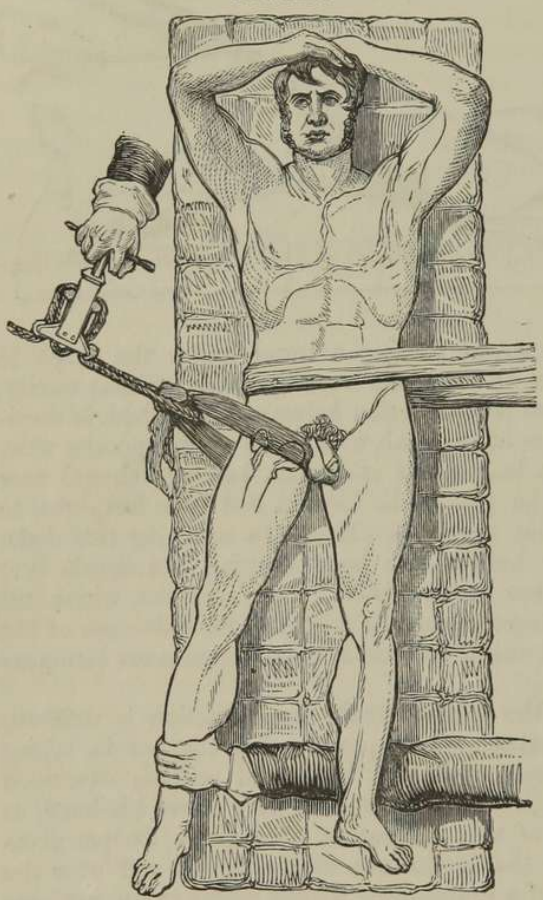
In the dislocation *downwards into the obturator foramen* we find the hip flattened, and the prominence of the trochanter completely absent, or indeed replaced by a depression. The limb is lengthened by about two inches, advanced before the other, and considerably abducted (fig. 123). The knee is bent and incapable of extension; the foot usually points forwards, but is sometimes

slightly everted, and is widely separated from its fellow. The body is bent forwards in consequence of the tension of the psoas and iliac muscles, and in thin persons the bone may be felt in its new situation.

This dislocation appears to be occasioned by the limb being suddenly and violently abducted, as by falls, with the legs widely separated; in consequence of which the head of the bone is tilted against the inner side of the capsule; and rupturing this, is thrown into the thyroid notch.

In the *reduction* of this dislocation the patient should be placed upon his back, the counter-extending girth, or towel, is then placed round the pelvis, and fixed firmly to a staple next to the sound side of the patient. A padded girth is then to be placed between the perineum and the upper part of the dislocated thigh. From this, extension is made by means of the pulleys or the tourniquet, which are fixed to a staple at a little distance from the injured side of the patient. Extension having then been made to such a degree as to elevate the head of the bone from the depression in which it lies, the surgeon passes his hand behind the sound leg, and seizing the ankle of the injured limb, draws it backwards and towards the mesial line, taking care to keep the knee straight, and thus throwing the head of the bone into the acetabulum by the action of a long lever (fig. 126).

Fig. 126.



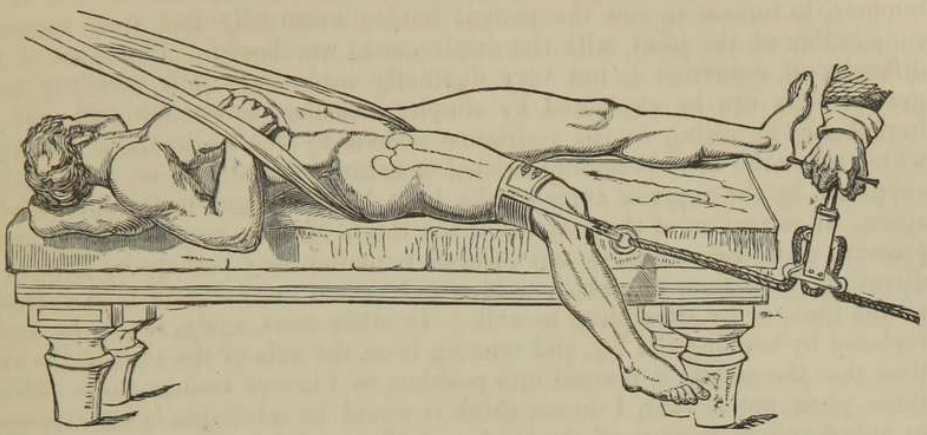
The dislocation *upwards* (fig. 124) *on the pubes* presents very unequivocal signs. The hip is flattened; the head of the bone can be distinctly felt lying in its new situation above Poupart's ligament, to the outer side of the femoral vessels, where it may be made to roll by rotating the limb. The thigh and knee are slightly flexed, rotated outwards, and abducted; the limb, which is separated from its fellow, is shortened to the extent of an inch.

The cause of this dislocation is either direct violence applied to the back of the thigh whilst the limb is abducted, or from the patient making a false step in walking, and suddenly throwing his body backwards in order to avoid a fall, twisting and displacing the limb.

With regard to the treatment, Sir Astley Cooper advises that the patient should lie upon his back, with his legs widely separated; and that counter-extension being then made by a girth carried between the perineum and the injured thigh, and fixed to a staple in front of and above the body, the pulleys should be fixed upon the lower part of the thigh, and the extension made downwards and backwards. After this has been continued for a sufficient time, an assistant lifts the head of the bone by means of a towel over the brim of the acetabulum (fig. 127).

The dislocation behind the tuberosity of the ischium is of very rare occurrence.

Fig. 127.



Dislocations of the patella are not frequently met with. They may, however, occur in four directions, viz. outwards, inwards, upwards, and edgeways or vertically.

The dislocation *outwards* is the most common variety of the accident, the bone being thrown upon the outer side of the external condyle of the femur, with its axis directed somewhat backwards and downwards. The knee is flattened in front, and is broader than usual; the patella can be felt in its new situation, and the muscles that form the quadriceps extensor are rendered tense, more especially the vastus internus; the leg is sometimes extended, but more frequently the knee is slightly flexed. This accident usually happens from sudden muscular contraction in persons who are knock-kneed. In some cases it has been occasioned by direct violence, driving the bone out of its position. Most frequently the dislocation is not quite complete, the patella being only partially displaced outwards, with some rotation of the bone in the same direction.

The dislocation *inwards* is of very rare occurrence; Malgaigne, who has investigated this subject, being of opinion that there is only one case of the kind on record.

In these lateral dislocations, reduction may be effected by laying the patient on his back, bending the thigh on the abdomen, and raising the leg so as to relax the extensor muscles. The surgeon then, by pressing down that edge of the patella which is furthest from the middle of the joint, raises the other edge, which, being tilted over the condyles, is immediately drawn into position by the action of the extensors.

A remarkable form of dislocation of the patella is that in which this bone becomes twisted upon its axis in such a way that it is placed *vertically*, one of its edges being fixed between the condyles, or upon the external one, and the other projecting under the skin, and pushing this forwards into a distinct tumor. In some cases the bone is turned almost completely round, the posterior surface becoming partly anterior. The signs of this dislocation are evident, manual examination indicating the vertical displacement of the patella, with a deep depression on either side. The limb is completely extended, flexion being impossible.

This peculiar dislocation has most generally arisen from sharp blows or severe falls upon one edge of the patella, whilst the limb was semi-flexed, in consequence of which the bone appears to have been semi-rotated and fixed in its new position. Violent muscular contraction, however, conjoined with a twist of the leg, but without any blow, has been known to occasion it in some cases.

The *reduction* of this displacement is always attended with great difficulty, and indeed in some cases has been found to be quite impracticable — surgeons having ineffectually attempted, by means of elevators and the section of the tendons, to replace it, and the patient having eventually died from traumatic suppuration of the joint, with the displacement unrelieved. The cause of this difficulty of reduction is not very distinctly made out: it is certainly much greater than can be explained by simple muscular contraction, and may not improbably be owing to the resistance offered by the aponeurotic structures which cover the bone becoming twisted or entangled under it, or, as Malgaigne supposed, by the superior angle of the bone being wedged in the *subcondyloid* space. If relaxation of the muscles of the thigh, and the employment of proper pressure upon the patella, do not succeed, reduction may perhaps be effected by directing the patient to make a sudden and violent muscular effort at extension of the limb, or by attempting to walk. In other cases, again, it may be readily replaced by bending the leg, and rotating it on the axis of the tibia at the same time that the patella is pressed into position, as Vincent recommends. Should these plans not answer, I do not think it would be advisable to have recourse to subcutaneous section of the tendon of the quadriceps extensor and of the ligamentum patellæ. In one case, in which both these structures were divided, the patella remained as firmly fixed as ever, and the patient eventually died of suppurative inflammation of the knee-joint; and in no case in which it has been practised, does it appear to have facilitated the reduction of the bone.

Dislocation of the patella *upwards* can only occur as a consequence of the rupture of its ligament. This accident, which is always accompanied by much inflammation of the joint, requires the same treatment as a fractured patella.

Dislocations of the Knee. — This joint, owing to the breadth of its articular surfaces, and the great strength of its ligaments, is seldom dislocated. When such an accident happens, it usually arises from falls from a great height, or by the patient jumping from a carriage in motion. The tibia may be displaced in four directions: forwards, backwards, or to either side. Besides these displacements, the joint is subject to a partial luxation dependent upon displacement of the semi-lunar cartilages.

The *lateral* dislocations of the tibia are the most common. They are always *incomplete*, and are usually accompanied by a certain degree of rotation of the limb in an outward direction. These displacements may either be *external* or *internal*. In the first, the outer condyle of the femur rests upon the inner articular surface of the tibia. In the other, the inner condyle is placed upon the outer articular surface of the head of this bone. In either case the knee is slightly flexed; there is a marked sulcus in the situation of the ligamentum patellæ; the extensor muscles of the thigh are relaxed, and the deformity of the joint indicates at once the nature of the displacement to which the bones are subject. In these cases reduction is always easy; indeed, occasionally it is effected by the unaided efforts of the patient, or by a bystander. It may be accomplished by flexing the thigh upon the abdomen, then extending the leg, and, at the same time, by a movement of rotation replacing the bones in proper position.

The dislocation *backwards* may be *complete* or *incomplete*. When complete, the posterior ligament of the joint is torn, the muscles of the ham are stretched, the limb is shortened to the extent of an inch and a half or two inches, and is semi-flexed; the head of the tibia can be felt in the ham, and there is a deep transverse depression in front of the joint immediately below the patella.

The dislocation of the tibia *forwards* is of more frequent occurrence than the last accident. In it, the lower end of the femur is felt projecting into the ham, compressing the vessels to such an extent occasionally as to arrest the circula-

tion through the lower extremity, lacerating the ligaments and stretching the muscles in this situation. The tibia is felt to project forwards, its head forming a considerable prominence on the anterior part of the knee, with a deep depression immediately above it and the patella, which is rendered more evident by the extensors of the thigh being relaxed; the leg is usually rotated somewhat inwards or outwards, and there is shortening to the extent of about two inches.

These antero-posterior dislocations are very commonly incomplete. When this is the case, they present the same symptoms, but to a less marked degree, that characterize the comple displacements.

In the *treatment* of these dislocations, extension should be made from the ankle whilst the thigh is fixed in a semiflexed position; when the leg has been drawn down sufficiently, proper manipulation will bring the bones into accurate position; splints must then be applied, means taken to subdue local inflammation, and the joint kept perfectly at rest for two or three weeks, at the end of which time passive motion may be commenced.

The *subluxation of the knee*, or "internal derangement of the knee joint," is an accident of more frequent occurrence than any of those that have just been described. It usually occurs by the patient, whilst walking, striking his toe against or tripping upon a stone, when he is suddenly seized with acute and sickening pain in the knee, often so severe as to cause him to fall to the ground. Before doing so, however, he is conscious of having strained or otherwise injured the joint. On examination it will be found semiflexed, the patient being unable to extend the limb properly, and every effort being attended by severe pain. In the course of a very short time the joint becomes swollen, being distended by synovial secretion, and symptoms of subacute synovitis are speedily superadded to the original injury.

This accident, originally described by Hey, and since investigated by Sir A. Cooper and others, is owing to the semilunar fibro-cartilage slipping away from under the internal condyle, either before or behind it, so as to bring its surface and that of the tibia into direct apposition. The severe pain that is always experienced is owing, in all probability, to the nipping of the loose folds of synovial membrane that lie within the joint, and that go by the name of the mucous and alar ligaments, and also to the great stretching of the ligaments by the partial displacement of the bones. The reduction may be effected by flexing the joint, and then, when the muscles are off their guard, the patient's attention being directed elsewhere, rapidly extending it at the same time that a movement of rotation is communicated to the leg. The evidence of complete reduction consists in the power of extending the articulation being regained by the patient. The synovitis that usually follows upon this injury requires to be treated by local antiphlogistics and rest. After it has been subdued, the patient should wear a laced knee-cap, as the joint will be weakened and liable to a recurrence of the same injury.

Dislocations of the knee-joint are more liable to serious complications than those of any other articulation. Not only are the ligaments torn, and the muscles injured, but stretching and perhaps laceration, of the popliteal vessels, followed by gangrene of the limb, may occur; or the joint may fall into a state of suppurative and destructive inflammation, as the result of the injury.

Compound dislocation of the knee-joint constitutes one of the most serious injuries to which the limbs are liable; the external wound being usually large, ragged, and accompanied by the protrusion of the condyles of the femur, with much laceration of the soft structures in the vicinity of the joint. These are cases that certainly, as a general rule, call imperatively for amputation; indeed, Sir A. Cooper looks upon this injury as especially demanding removal of the limb. Cases, however, have occurred in which the limb, even under these circumstances, has been saved. Hence, if the patient is young, and if the vessels of the ham do not appear to have been seriously injured, the wound in the soft

parts at the same time not being very extensive, or much bruised, an attempt may, with propriety, be made to save the joint. In a case of compound dislocation of the knee forwards, in a boy, the late Mr. A. White sawed off the projecting end of the femur which protruded through the ham, and bringing the wound together, succeeded in saving the limb.

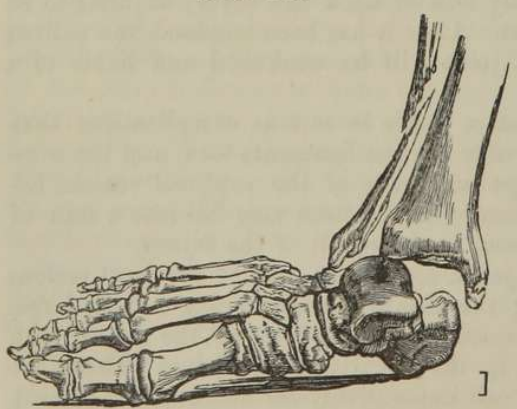
The head of the fibula has occasionally, though very rarely, been displaced by the application of direct violence to it. Boyer and Sanson have each recorded a case of this kind.

Dislocations of the ankle occur in consequence of displacement of the astragalus from the bones of the leg, whilst it continues to preserve its normal connection with the rest of the foot. These dislocations are almost invariably connected with fracture of the lower end of the fibula, or of the inner malleolus. In fact, in looking at the arched cavity into which the astragalus is received, it is evident that this bone can scarcely be displaced laterally without fracture of one side of this arch. In considering these dislocations we must, in accordance with the general nomenclature of similar accidents, in which the distal part is always said to be displaced from the proximal, look upon the foot as being dislocated from the leg, and not consider the tibia as being displaced upon the foot. The direction of the dislocation must consequently be determined by the position into which the articular surface of the astragalus happens to be thrown. It is necessary to explain this, inasmuch as a good deal of ambiguity occurs in surgical writings from the same accident being described differently, according to the view taken of the part displaced. Thus, Sir A. Cooper speaking of the tibia as being dislocated at the ankle, whilst Boyer and others regarding the foot as the part displaced, have described the same injury in directly opposite terms.

Dislocations of the foot may take place in four directions, viz., laterally, on either side; backwards, and forwards. In all cases, the injury appears to be occasioned either by the foot being twisted under the patient in jumping or running: or else by its being suddenly arrested by coming in contact with the ground whilst the body is carried forwards.

The dislocation *outwards* is of most frequent occurrence. In it the inner malleolus projects forcibly against the skin; there is a depression above the outer ankle corresponding to a fracture of the fibula, and the sole of the foot is turned upwards and outwards; the inner side touching the ground, whilst the outer edge is turned up. (Fig. 128).

[Fig. 128.



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In the dislocation *inwards*, which is a rare accident, and according to Sir A. Cooper, a much more dangerous one than that just described, the fibula is not fractured, but the lower end of the tibia is splintered off, in an oblique manner, from within outwards. The outer edge of the sole rests against the ground, and the inner side is turned upward.

The *reduction* of these lateral displacements is readily effected by simple traction into proper position; leg-splints with lateral foot-pieces must then be put on, or Dupuytren's splint may be applied on the same side as the dislocation, opposite to that on which the eversion of the foot takes place.

In the dislocation of the foot *backwards*, the deltoid ligament is ruptured, the

fibula broken in the usual situation, and the tibia thrown forwards on the navicular and internal cuneiform bones; the foot is consequently shortened, and the heel rendered more projecting. The dislocation *forwards*, in which the foot is lengthened, and the tibia thrown upon the upper and posterior surface of the os calcis, behind the astragalus, is an accident of such rare occurrence as seldom to have been witnessed, although described. In the treatment of these antero-posterior displacements of the ankle, traction of the foot in a proper direction, the leg being fixed and flexed upon the thigh, will readily be attended by replacement of the bones, the application of lateral splints being afterwards sufficient to keep the parts in proper position.

Compound dislocations of the ankle-joint are serious, but by no means unfrequent accidents, the displacement occurring in the same direction and from the same causes as the simple forms of injury.

The *treatment* of these cases must depend to a considerable extent upon the amount of laceration of the soft parts, and the condition of the bones forming the arch of the joint. If the wound in the soft parts be not considerable in extent, clean cut, and with little injury to the bones, the limb should be placed on a M'Intyre's splint; and the lips of the wound, being well cleaned, brought together by strapping, or covered by lint soaked in collodion; evaporating lotions may then be applied, the constitutional condition of the patient carefully attended to, and the case treated much in the same way as a compound fracture. In many instances this plan will suffice, and the patient will recover with a useful limb, the joint being only partially anchylosed.

If, however, the bones be projecting and comminuted, and the wound more extensively lacerated, the question of amputation will necessarily arise. In many cases the operation may be dispensed with by adopting the treatment recommended by Mr. Hey, of sawing off the malleoli, removing splinters of bone, cleaning the wound, bringing together its edges by simple dressing, and supporting the limb at the same time upon a M'Intyre's splint. If the joint be still more seriously injured, the posterior tibial artery torn, or the foot greatly contused, or if the patient's constitution be shattered and irritable, primary amputation should be had recourse to. I believe, however, that the disinclination on the part of surgeons to amputate in these cases, owing to the strong expression of opinion by Sir A. Cooper in favor of the attempt to save the limb, has in many cases been carried to such an extent as seriously to endanger the patient's life. Secondary amputation may be rendered necessary, in consequence of gangrene, erysipelas, or extensive suppuration.

Dislocations of the Astragalus. — The astragalus is occasionally displaced from its connection with the bones of the leg above, and with those of the tarsus below, being thrown either forwards or backwards, the displacement forwards happening far more frequently than that in the opposite direction. In the dislocation *forwards*, the head of the bone may be thrown either *outwards* or *inwards*, but I do not think there is any evidence to show that complete lateral dislocation of this bone can occur irrespective of displacement forwards; the so-called *lateral* dislocations being displacements of the bone forwards, with twists to one or other side. In the luxation backwards there is no rotation of the bone, which is thrown directly behind the tibia, in the space between it and the tendo Achillis.

These dislocations invariably happen from falls upon, or twists of the foot; more particularly when it is in a state of extension upon the leg. When the foot is in this position, the lower end of the tibia either breaks off on the application of sufficient violence, or the head of the astragalus is forced out of the cavity of the scaphoid, and its bed on the os calcis, the particular kind of displacement that occurs depending upon the direction in which the force is acting and in which the foot is twisted.

The dislocation of the astragalus *forwards* with twist of the bone inwards, is

said to be of most common occurrence, although I have more frequently witnessed that form of accident in which the bone is thrown somewhat outwards as well as forwards. In either case the displaced bone forms a distinct tumor upon the instep, in the outline of which the form of the astragalus can be distinctly made out. Over this, the skin is so tightly drawn as often to appear to be on the point of bursting. When the bone is thrown somewhat inwards the foot is turned outwards, and the internal malleolus projects distinctly. When the astragalus is thrown outwards, displacement of the foot in an inward direction, with great projection of the lower end of the fibula, takes place. In some cases, fracture of the neck of the astragalus is conjoined with these dislocations, and not uncommonly the luxation is compound from the very first, or speedily becomes so if left unreduced, in consequence of the sloughing of the skin which covers the anterior surface of the bones, the exposed portion of which undergoes necrosis, and perhaps, eventually, exfoliation.

The dislocation *backwards* into the hollow, under the tendo Achillis, is of rare occurrence, there being but seven recorded instances of this accident. In the majority of these there was displacement of the bone *inwards*, as well as backwards. In these cases the diagnosis is easy, as the bone forms a distinct prominence, which can be felt under the tendo Achillis.

In many cases the dislocation of the astragalus is not altogether complete, the under surface of the tibia not coming into direct contact with the upper surface of the os calcis; a portion of the astragalus still intervening between these articulations.

The *reduction* of the dislocation *forwards*, whether attended by lateral displacement or not, varies greatly in the facility of its execution; in some instances being effected with the greatest possible ease, in others being attended by almost insurmountable difficulties. This difference in the facility of reduction depends, I think, on whether the dislocation is complete or not. When the astragalus is not completely thrown from under the arch formed by the bones of the legs, portion of it being still entangled between their articular surfaces and that of the calcaneum, it may usually be readily reduced by relaxing the muscles of the calf, and pushing the bone back into its proper position. But when the astragalus is completely dislocated, the upper surface of the calcaneum is drawn up under the arch of the malleoli by all the strength of the muscles that pass from the leg to be inserted into the foot. Under these circumstances, in order that reduction take place, it is necessary first of all to separate the articular surfaces to such an extent as to admit of the astragalus being pushed back into its socket; this is almost impossible, owing to the great perpendicular thickness of this bone, to the extent to which it is consequently necessary to draw down the foot, and to the little purchase that can be obtained on it. In such cases as these, the reduction has been greatly facilitated by the division of the tendo Achillis, by which simple operation the whole strain of the muscles of the calf is taken off.

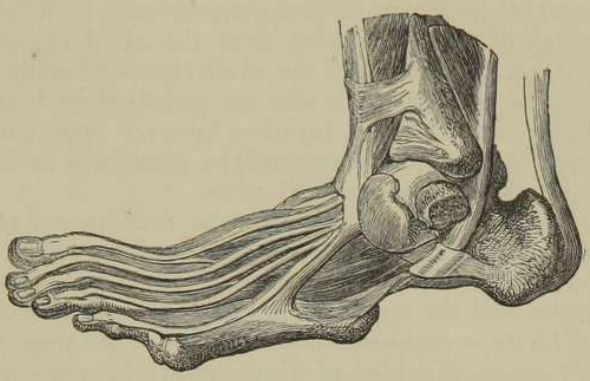
If reduction is still impracticable, the bone must be left in its new situation. If this be in the direction forwards, the skin will usually slough, and then a portion of the exposed osseous surface, which will probably necrose, may be excised, or the whole of the astragalus dissected out by freely exposing it and severing its ligamentous attachments; the patient recovering with a somewhat stiffened, but still useful, joint. This plan appears to be safer than excising the bone in the first instance so soon as the dislocation has been found to be irreducible.

In luxation *backwards*, the bone has not hitherto been reduced, except in one case which occurred in University College Hospital, and in which the tibia and fibula were fractured. It is by no means improbable that subcutaneous division of the tendo Achillis may in future enable the surgeon to do this. The result is, however, satisfactory, even though the bone be not noticed, the patient recovering with a useful foot. If left unnoticed, the soft parts covering the

bone may slough, as happened in a case recorded by Dr. Williams, of Dublin, in which the bone was consequently extracted.

In *compound dislocation* of the astragalus (fig. 129), the rule of practice must depend upon the extent of injury. If the integuments have merely been rent in consequence of the tension to which they have been subjected by the outward pressure of the displaced bone, an attempt must be made to reduce the dislocation, and if this be effected, to close the wound by the first intention. If the bone be comminuted as well as dislocated, the proper practice will be to remove the loosened fragments, and to dress the wound in the simplest manner, allowing it to heal by granulation. If the bone be irreducible, it is a question whether it should be left or dissected out. If it be left, the wound in the integuments will certainly extend by a sloughing process, the bone will inflame and become carious or necrosed, exfoliating in fragments, and the patient will only recover after a prolonged, tedious, and dangerous course of treatment. Under these circumstances, therefore, it appears to me that the simpler and safer plan both to limb and life consists in enlarging the wound in proper directions, so as to dissect out the irreducible astragalus, and then bringing the articulating surfaces in contact, dressing the parts lightly, and trusting to the formation of a new joint between the tibia and the os calcis So, also, if a simple dislocation of the astragalus become compound in consequence of the sloughing of the superjacent tense integuments, the exposed and necrosing bone should be removed in part or in whole, according to the circumstances of the case. If, together with the dislocation of the astragalus, the foot be extensively crushed, amputation may be required either at the ankle-joint or at some convenient part of the leg.

Fig. 129.



Dislocation of the other *tarsal bones* is of extremely rare occurrence. Most of them, however, have been found to have been luxated at times. Thus, for instance, the *calcaneum* has been dislocated laterally from its connections with the cuboid in consequence of falls from a height, the sufferer alighting upon his heel. Chelius mentions a case in which this bone was dislocated by the effort of drawing off a tight boot. The reduction seems to be readily effected by relaxing the muscles, and pressing the bone back into its proper position.

The *scaphoid* and *cuboid* bones have been found to be dislocated upwards in consequence of a person jumping from a height and alighting upon the ball of the foot. In these instances the limb is shortened and curiously distorted, the toes pointing downwards, the arch of the instep being increased so as to resemble closely enough the deformity of club-foot. Reduction may be effected by drawing and pressing the parts into position.

The *great cuneiform* bone has occasionally been found to be dislocated. Sir A. Cooper mentions an instance of this kind. If reduction be not effected by pressing the bone into its position, no great evil appears to result to the patient, the motions of the limb not being seriously interfered with.

Dislocation of the *metatarsal bones*, though excessively rare, from the manner in which they are locked in between the bones of the tarsus, and retained by short and strong ligaments, yet occasionally occurs; instances being recorded by Dupuytren and Smith. Liston also mentions a case of luxation of the meta-

tarsal bone of the great toe from direct violence. Tufnell records a case of luxation downwards and backwards of the three internal metatarsal bones, from a fall upon the leg by a horse rolling on its rider. Luxations of the *phalanges* of the toes but rarely happen, and present nothing special in nature or treatment.

Besides these instances of dislocations, properly so called, it occasionally happens that accidents are met with that may in strictness be referred to this head, though differing somewhat from the usual characters of luxations. Thus, for instance, the *sutures of the skull* are occasionally separated, in consequence of blows on the head. So also the articulations between the *vertebræ* may suffer displacement. These injuries, however important, from the effects produced upon the contained organs, will be considered in the next chapters when treating of injuries of the head and spine.

It occasionally happens, that in consequence of severe blows upon, or compression of, the *pelvis*, the symphysis of the pubes, or the sacro-iliac articulation, is displaced; here the nature of the injury is indicated by the deformity that results, and the same treatment is required as in fractured pelvis.

The *lower angle and dorsal border of the scapula* is occasionally the seat of a very remarkable kind of displacement, in consequence of which it projects at a considerable angle from the trunk, giving a winged appearance to the back. The cause of this peculiar displacement is somewhat obscure; by some it is considered to be dependent upon the bone slipping away from under the posterior edge of the latissimus dorsi muscle; by others again, and apparently with more reason, it is considered to be owing to paralysis of the serratus magnus. Whether this be dependent upon some morbid condition of the muscle itself, as Dr. Jacob supposes, or be owing to a paralyzed state of the long thoracic nerve, as Nélaton thinks, can scarcely be determined. In such cases as these, I have seen some benefit derived from the endermic application of strychnine on a blistered surface, and afterwards support by means of a properly constructed apparatus.

INJURIES OF REGIONS.

CHAPTER XVIII.

INJURIES OF THE HEAD.

THE consideration of injuries of the head is one of the most important studies that can engage the surgeon's attention. The importance attached to it is not so much due to the special considerations connected with the mere injury of the scalp and cranium; but rather to the effects that are produced as the result of the implication of the brain and its membranes, in many cases directly, and in others indirectly, owing to the close connection that subsists between the actions that take place in the external and internal structures of the head. In consequence of this tendency to cerebral complication, it is of the first moment in practice to study these injuries as a whole, and with special regard to those affections of the encephalon produced by them; and from which the injury of the scalp and the fracture of the cranium derive the greater part of their importance. It is therefore necessary in the first instance to be acquainted with the nature and treatment of the principal forms of cerebral affection that super-

vene upon these accidents, before we proceed to study the special nature and peculiar modifications of treatment required by the conditions that occasion them.

CEREBRAL DISTURBANCE.

There are two principal states of functional disturbance arising from injury to which the brain is subject, viz., *concussion* and *compression;* either of these may be followed by, or be complicated with, inflammatory actions of various kinds, that derive much of their peculiar characteristics from the condition with which they are associated, and from the injury by which they are occasioned.

1st. *Concussion* or stunning appears to be a shock communicated to the nervous system from the application of such external violence as will produce commotion of the substance of the brain, or interfere with the circulation through it; in consequence of which its functions become temporarily suspended, usually in a slight and transitory degree, but occasionally to such an extent that the patient does not rally for many hours from the depressed state into which he is thrown, and perhaps sinks without recovery. In those cases in which death immediately results from the continuance and severity of the concussion, either no lesion at all may be found in the cerebral substance, or it may have been rendered so soft and semi-diffluent by the shock to which it has been subjected, as to be evidently incompatible with life, even though no distinct rupture of its substance appears to have taken place. In other cases, again, more serious injury, such as rupture of it, may have occurred.

In the slighter cases of concussion — that degree indeed which invariably accompanies any severe injury of the head—the surface becomes cold and pale; the sufferer is motionless and insensible, or only answers when spoken to in a loud voice, relapsing again into speedy insensibility, or rather semi-consciousness; the pulse is feeble, the pupils contracted, and the sphincters usually relaxed; the limbs are flaccid, and muscular power is lost. After continuing in this condition, which is the first stage of concussion, for a few minutes or hours, according to the severity of the shock, the second stage comes on, the circulation gradually re-establishing itself, the pulse becoming fuller, and the surface warmer. About this time the patient very commonly vomits; the straining accompanying this effort appears to be of service in stimulating the heart's action, and driving the blood with more vigor to the paralyzed brain, thus tending to restore its functions; and we accordingly find that, after vomiting has occurred, the sufferer quickly rallies. In the more severe cases, the symptoms that have just been described are so strongly marked that the patient appears to be moribund; there is complete prostration of all nervous and physical power; the surface being cold and death-like, the eyes glassy, the pupils either contracted or widely dilated, the pulse scarcely perceptible and intermittent. In this state the patient may lie for hours, recovery being slow, and the concussion merging into some other, and perhaps more serious affection of the nervous centres, or, indeed, in some cases, speedily terminating in death, apparently by failure of the heart's action.

The *terminations* of concussion are various. We have already seen that in some cases this affection may speedily give way to complete recovery, although slight headache, some degree of giddiness, confusion of thought, and inaptitude for mental occupation, may last for a few days before the mental powers are completely re-established. In other cases again, the concussion may rapidly terminate in the patient's death, but between these conditions there are several intermediate states. Thus the recovery may be complete, but a permanently irritable state of brain may be left, the patient, though capable of the ordinary duties of life, becoming readily excited by slight excesses in diet or in the use of stimulants, or by mental emotion, though not of an inordinate intensity. These individuals, suffering from a preternaturally irritable brain frequently die

suddenly in the course of a few months, or a year or two, after the receipt of the injury.

In other cases the recovery continues to be incomplete, although the patient may be enabled to follow his usual occupation, and to mix in the ordinary business of life; but yet his state is a precarious one, the brain being liable to the occurrence of inflammatory disease on the slightest exciting cause. In such cases as these, there is frequently a certain degree of impairment of mental power, the memory failing either generally or in certain important points, as with reference to dates, persons, places, or language. The speech is perhaps indistinct and stuttering. Amaurosis of one or both eyes, with perhaps squinting or paralysis of the eyelid, may be left. The hearing may be impaired, or noises of various kinds set up in the ears. There may be diminution or loss of muscular and of virile power, especially, as Hennen observes, in those cases in which the injury has been inflicted upon the back of the head; and Holberton has noticed that when the medulla oblongata has been injured, the pulse may continue preternaturally slow—an observation that I have had several opportunities of confirming in injuries both of the medulla, the pons, and the crura cerebri. For these symptoms to occur, it is by no means necessary that the original local injury should have been a severe one. In some cases, in railway accidents more especially, or in falls from a height, the whole nervous system appears to be jarred and concussed without any wound or apparent sign of internal injury of the head. At first the symptoms of concussion are but slight, perhaps even none are apparent, and the sufferer congratulates himself on his escape, but gradually impairment of nervous power, manifesting itself in one or other of the ways just mentioned, comes on, and the health continues broken through life.

In other cases again, the symptoms of concussion may gradually terminate in those of compression, and not unfrequently the reaction that comes on, passing beyond the bounds that are necessary for the re-establishment of the healthy functions of the brain, terminates in an inflammatory condition of this organ.

2nd. *Compression of the brain* is a common condition in injuries of the head, arising as it does from a great variety of causes;—from the pressure of a portion of bone, of blood extravasated, or pus formed within the cranium, or from a foreign body lodged there. In whatever way occasioned, however, the symptoms, although presenting some differences, are tolerably constant. The patient lies in a state of coma, stupor or lethargy, being paralyzed more or less completely, heavy, insensible, and drowsy, not answering when spoken to, or only when addressed in a loud voice and shaken perhaps at the same time. The breathing is carried on slowly and deeply, with a stertorous or snoring noise, and usually a peculiar blowing with the lips: one or both pupils are dilated; the pulse is full, often slow; the fæces passing involuntarily, and the urine not uncommonly being retained; the skin may be cool, but in many cases, on the contrary, is rather hot and perhaps perspiring;—not unfrequently this state of stupor alternates with paroxysms of delirium, or of local convulsive action.

This state of coma may become complicated by the occurrence of symptoms of inflammation: and unless the cause that produces the compression be removed, it usually terminates speedily in death, the patient gradually sinking into more complete unconsciousness, and dying in an apoplectic condition. In other, but much rarer cases, the coma may continue almost an indefinite time, for many weeks or even months, until the compressing cause is removed, when the patient may recover consciousness, and the symptoms suddenly disappear.

The diagnosis between concussion and coma has been sufficiently indicated in the preceding description of these two conditions as not to require special mention here. But, in many cases, it must be remembered that one state merges into the other, so that the symptoms are not so distinctly marked as has

been indicated, and they are more especially obscured when associated with inflammatory action.

3rd. There is another condition of the brain, which, although differing completely from concussion and compression, not unfrequently complicates these states, or may supervene independently of either, upon severe injury of the head. For want of a better term, this may be called *irritation of the brain*, and appears often to be connected with laceration of the cerebral substance. In it the patient lies in a state of semi-consciousness, unobservant of what is going on around him, unless spoken to or roused. He does not, however, lie quietly, but moans, tosses himself about, and not unfrequently twists and curls himself forwards, with his back bent, and the knees drawn up towards the chest. When spoken to, he answers in a peevish and irritable manner, if at all: frequently frowning and distorting his countenance, and being evidently pained at any attempt at fixing his attention. He is occasionally convulsed, and, at other times, is seized with fits of violent delirium, shouting and screaming. The pulse is usually slow and feeble, the skin cool, and the face pale, with a total absence of all signs of inflammation. This condition most generally terminates speedily in convulsions, coma, and death.

4th. *Inflammation of the brain and its membranes* from injury (*traumatic encephalitis*), is an affection of great frequency and corresponding importance. It is a condition that is specially apt to supervene in all injuries of the head; though the liability to it necessarily increases with the severity of the accident. This form of inflammation of the brain and its membranes may set in with great intensity in some cases, the symptoms of phrenitis being strongly marked; in other instances, again, it gradually creeps on in a slow and insidious manner, not attracting attention until it has given rise to some severe and ulterior consequences, as effusion or suppuration, when its symptoms become so mixed up with those of compression and of irritation, as to make the exact diagnosis of the patient's condition far from easy. The period at which inflammatory symptoms of the brain may manifest themselves, after an injury of the head, varies greatly. In some instances they set in almost immediately on the patient recovering from the effects of the concussion; the reaction from this state gradually assuming an inflammatory character. In other cases it is not until after the lapse of several days that inflammation declares itself; and, again, it sometimes happens that the inflammatory affection does not supervene for weeks or months; but then, occurring perhaps under the influence of comparatively trivial causes, may destroy the patient.

After death, in cases of traumatic encephalitis, we usually find both the brain and its membranes affected. The arachnoid is, however, the structure that appears principally to suffer in these cases, being thickened, so as to become milky and semi-opaque. Adherent lymph of a greenish-yellow colour, and opaque purulent appearance, is seen covering one or both hemispheres of the brain, being deposited in largest quantity at the seat of injury, and not unfrequently extending across and into its fissures, occupying especially the depressions about its base. The vascularity of the brain and its membranes is greatly increased, the arachnoid being reddened in patches, and the vessels of the pia mater becoming turgid and very numerous, forming a vascular net-work over the surface of the brain. The sinuses also are distended with blood, the cerebral substance exhibits an increase in the quantity of red points, so as often to present a somewhat rosy hue; and the ventricles are filled with reddish semi-turbid serum, a large quantity of which is effused about the base of the brain. In some of the more advanced cases, inflammatory softening of the cerebral substance may occur.

In considering the symptoms of traumatic encephalitis it is useless to endeavor to make a distinction between the inflammation of the brain and that of its membranes; the two structures being always more or less implicated at the same

time. The most practical division of this disease following injury, is into the acute and the chronic, or sub-acute encephalitis

The *acute encephalitis* usually comes on within eight-and-forty hours of the infliction of the injury. The patient complains of severe, constant, and increasing pain in his head; the scalp is hot, the carotids beat forcibly, the pupils are contracted, the eyes intolerant of light, and the ears of noise; the pulse is full, vibrating, and bounding; and wakefulness, with delirium, usually of a violent character, speedily comes on. All the symptoms of severe constitutional pyrexia set in at the same time.

By active and proper treatment this condition may gradually subside until the health is re-established, but more commonly the symptoms of inflammation merge into those of compression; the delirium becoming replaced partly or in whole by a state of stupor, from which the patient is roused with difficulty, the pupils gradually dilating, the breathing becoming heavy and stertorous, the pulse sometimes continuing with its former rapidity, at others becoming slow and oppressed. The skin is hot but clammy, the patient falls into a heavy, dull, unconscious state, which alternates with convulsive twitchings or jerkings, and occasional delirious outbreaks. As death approaches, the sphincters become relaxed, the pulse more feeble, the surface cooler, and the coma more intense and continuous, until the patient sinks from exhaustion and compression conjoined. In cases such as these, pus may be found upon the surface, or within the substance of the brain, in one case being diffused, in the other collected into a more or less distinctly circumscribed abscess. In other cases again, the symptoms of compression appear to be induced by a thick layer of lymph lying upon the surface of the brain, or by a quantity of serous fluid being poured out into the ventricles and about the base.

The *chronic or sub-acute encephalitis* is the most interesting and important variety of inflammation following injuries of the head. It may come on a few days after the infliction of the injury, or not until months have elapsed. It may arise from accidents that simply implicate the skull, as well as from those that extend their direct effects to the brain and its membranes. The patient in many cases has apparently recovered entirely from the accident, though in others it will be found that some one symptom indicative of the brooding mischief still continues, such as headache, or impairment of sight or of hearing Occasionally, the coming mischief is foreshadowed by an unusual degree of irritability of temper, by loss of mental vigor, or some other functional disturbance of the brain. In cases such as these the sub-acute encephalitis may suddenly come on, ushered in perhaps by an aggravation of the persistent symptom, or by the occurrence of an epileptic fit. In other cases again, the symptoms set in suddenly without any warning, but usually with much intensity, and speedily prove fatal.

The symptoms of the sub-acute encephalitis, when it has fairly set in, consist of those of inflammation, irritation, and compression of the brain conjoined; in some cases one, in other instances another, of the conditions appearing to predominate. The irritation and inflammation proceed from the increased vascular action; the compression from the effusion of serous fluid, of pus, or of lymph, exercising undue pressure upon the brain. The symptoms consist of pain in the head with heat of the scalp, and either dilatation or contraction of the pupils, occasionally one being dilated and the other contracted. Squinting, intolerance of light, delirium, moaning, or screaming, unconsciousness, with convulsive twitchings of the limbs and face, commonly occur with the ordinary symptomatic fever; and lastly, symptoms of coma, rapidly terminating in the patient's death.

In the sub-acute encephalitis the same appearances are very generally found after death, as in the more acute form of the affection, but it commonly happens that it is the arachnoid membrane that is principally affected. So constantly is

this the case, that some surgeons have proposed, and not altogether with injustice, to apply the term *arachnitis*, to this form of traumatic encephalitis, looking upon the inflammation of the arachnoid as the principal lesion.

5th. The *formation of pus within the cranium* is a point of much interest in these cases, and an endeavor has been made, especially by Pott, to lay down rules by which the occurrence of suppuration could be accurately determined. Thus it has been said, that if, during the continuance of encephalitis, fits of shivering come on, followed by the gradual supervention of coma, which slowly becomes more and more complete whilst the constitutional symptoms of inflammation do not subside; and if, at the same time, a puffy swelling forms upon the scalp, and the wound, if any, becomes pale and ceases to secrete, the pericranium separating from the bone, which is seen to be yellow and dry, an abscess will have formed under the skull; and further, that in all probability its seat will correspond to these changes in the scalp and pericranium.

In many cases, doubtless, these signs have afforded proof of the existence of pus within the cranium. It but seldom happens, however, that the signs attending the formation of pus within the cranium occur in the distinct order and with the degree of precision above stated. In the great majority of cases the surgeon can only suspect the presence of pus by the symptoms of inflammation terminating in paralysis or coma. But he cannot say with certainty that pus has formed, for the coma may arise from the pressure of other inflammatory effusions; but if the puffy swelling of the scalp or the separation of the pericranium occur, then he may feel himself justified in giving a more positive opinion as to its existence in some situation within the cranial cavity, probably beneath or in the neighborhood of the part thus affected.

In traumatic encephalitis secondary mischief often occurs in some of the thoracic or abdominal viscera, the lungs and liver being especially liable to be thus implicated. In the lungs, more particularly, it not unfrequently happens that congestion runs into some low form of pneumonia, and thus terminates the patient's existence. In the liver it has long been observed that abscesses are apt to form as a consequence of injuries of the head. These usually occur as one of the more remote consequences of the injury, but yet there have been instances of an acute kind. Thus, Hennen has seen an abscess form in the liver of a temperate woman, thirty-six hours after the receipt of a blow upon the head. This connection between abscess of the liver and injury of the head is doubtless the result of pyemia, consequent on the suppuration of the diploe of the skull, the hepatic abscess being a metastatic deposit of pus consequent upon inflammation of the veins of the diploe and of the cerebral sinuses.

The *treatment* of these various cerebral injuries, and their concomitant affections, is one of the most important and difficult subjects that can arrest the surgeon's attention; the difficulty depending in a great measure on the various conditions that have just been described, not occurring in practice with that amount of distinctness and individuality by which their characters can alone be conveyed in description, but being associated together in such a way that the exact state of the patient cannot so readily be made out. There are few cases, indeed, in which practical tact and a nice discrimination and analysis of symptoms are more required than in those now under consideration. It would, however, be useless to attempt to describe the shades and modifications of treatment required in the management of the different groupings of these various forms of traumatic cerebral disturbance. We must therefore content ourselves with describing the treatment of each state broadly and separately, and leave the consideration of the varieties that so commonly present themselves in practice to the individual tact of the surgeon.

In the treatment of *concussion*, the first great indication is to re-establish the depressed energies of the circulation and of the nervous system. In effecting this, we must, however, be careful not to over-stimulate the patient. The safest

practice is that which is applicable to the treatment of shock generally; — to wrap the patient up warmly in blankets, to put hot bottles around him, to employ frictions to the surface, and when sufficiently recovered to allow him to swallow a small quantity of warm tea. Stimulants of all kinds should be avoided, as their after-effects may be injurious; unless the depression of the nervous energy is so great that reaction cannot be brought about without their agency.

When reaction has come on, steps should be taken to prevent the occurrence of inflammatory mischief. With this view, if the concussion have been slight, it may be quite sufficient to purge the patient well, and to keep him quiet on a regulated diet for a few days, directing him carefully to avoid all alcoholic stimulants and mental exertion for some time. If the concussion have been more severe, and if the symptoms of reaction have been accompanied by indications of continuous cerebral disturbance, or been followed by giddiness, headache, or confusion of thought, the safer plan will be to adopt immediate steps for the prevention of mischief. The patient should be bled generally or locally by leeches and cupping, freely purged, kept on a low diet, and, above all, remain quiet in bed for some days.

Should impairment of the mental faculties or senses be left, the more prudent plan will be to have recourse to mild antiphlogistic treatment. Leeching, cupping, blistering, the introduction of a seton in the nape of the neck, purging, and more especially a mild mercurial course, with strict avoidance of all mental and bodily stimulation, is the plan of treatment that requires to be pursued. These cases must, however, be carefully watched, and kept under proper supervision for some length of time, as serious symptoms are apt suddenly to declare themselves.

When *acute inflammation* of the brain or its membranes has come on, at whatever period after the injury, active treatment should be at once adopted. The head must be shaved, and an ice-bladder kept constantly applied. Bleeding from the arm, repeated as often as the pulse rises, as well as by cupping or leeches, must be had recourse to; the bowels should be freely opened, and rigid abstinence must be enjoined, the patient at the same time being confined to a darkened room, and removed from all causes of excitement. Calomel should then be administered, so as speedily to affect the mouth. As the disease assumes a chronic form, the same general plan of treatment, modified according to the intensity of the inflammatory affection, must be persevered in, the patient being kept for a length of time after the subsidence of all the symptoms in a state of complete quietude.

The *subacute encephalitis* which occasionally follows injuries of the head, even at a remote period from their infliction, is a most dangerous and unmanageable affection, being very apt to terminate in loss or impairment of sense, in diminution of intellectual power, or in local paralysis. Much of the difficulty in the treatment of these cases appears to arise from the fact that the inflammation is often of a low or erysipeloid character, consequently not admitting of active depletory measures.

In these cases the best results are obtained by the proper administration of mercury and the employment of counter-irritants. The best mode of administering the mercury is to give calomel in small and repeated doses, half a grain or a grain every four or six hours until the gums are affected, and to keep them so by diminishing, but not leaving off the mineral. The repeated application of blisters over the shaven scalp is perhaps the most useful form of counter-irritant, to which, in more chronic cases, a seton in the neck may be added. So long as any symptoms of inflammatory action continue, this plan of treatment must be steadily kept up.

The *irritation of the brain*, that occasionally occurs as the result of injury, is best treated by a moderate antiphlogistic plan, conjoined in some cases, and in

others followed, by the administration of opiates. This is the only consequence of injury of the head in which opiates can advantageously be given. They should never be administered if there be any heat of head and fulness of pulse, having a great tendency to excite cerebral inflammation. But in that peculiar train of symptoms that occasionally follows injuries of the head, and which I have described as *irritation of the brain*, and in which there is a total absence of all inflammatory action, I have occasionally found a full dose of laudanum quiet the delirium, and, by inducing sleep, restore the patient. This, however, requires great care.

In all cases of coma from compression, the bowels should be freely opened by placing a drop of croton oil, mixed with a little mucilage, in the patient's meals, or by the use of oleaginous or terebinthinate enemata. The urine is to be drawn off twice in the twenty-four hours, the room darkened, and kept quiet, and ice or an evaporating lotion applied to the head.

When symptoms of *compression* occur as the result of inflammation in the cranium, the treatment becomes surrounded by difficulties. If, notwithstanding antiphlogistic measures have been pushed to their full extent, rigors occur and coma supervenes, conjoined with a certain amount of continuous inflammatory action, the question always arises as to whether trephining should be had recourse to, on the supposition of matter having formed. In these cases two great difficulties present themselves; the first has reference to the existence of pus within the cranium, and the second to its situation.

The question as to the actual existence of pus within the cranium, and the dependence of the symptoms of coma upon the compression exercised by the purulent deposit, is always a difficult one to determine. There are, as has already been stated, no absolute and unequivocal symptoms indicative of the formation of pus within the cranium, the same symptoms that accompany its formation being often closely simulated by the effusion of serum, or of puriform lymph, on the brain or its membranes. But although there may not be any symptom that is absolutely and unequivocally indicative of the formation of pus in this situation, it not unfrequently happens that the surgeon is enabled by the assemblage of general symptoms and local signs, to indicate its existence with considerable accuracy. In these cases, however, it is usually impossible to determine the exact seat of the purulent deposit with sufficient precision to admit of its evacuation by the trephine; — whether the pus be between the cranium and the dura mater, between the layers of the arachnoid, underneath this membrane, between the cerebral convolutions, or deeply seated in the substance of the brain; whether it be situated under the seat of injury, and be there circumscribed, or whether it be so extensively diffused as not to be capable of complete evacuation. That these difficulties are real, must be obvious to every practical surgeon, and illustrative of them I may mention the two following cases, out of many that I have witnessed.

A man was admitted into University College Hospital with an extensive lacerated wound of the scalp, denuding the pericranium. He continued free from all cerebral disturbance until the tenth day after the accident, when he complained of headache, had quick pulse, and a hot skin. At this time it was observed that the denuded pericranium had separated from the skull. He was treated by active antiphlogistic means, the symptoms subsiding, and went on favorably until the thirty-fourth day, when he suddenly became delirious and unconscious, though easily roused when spoken to loudly, and then answering rationally; his pulse fell to 48. He died on the thirty-ninth day, comatose. On examination after death, the pericranium was found detached at the seat of injury; under this the dura mater was thick, yellow, and opaque, but no pus was observable. On separating the hemispheres, however, a large abscess was found situated deeply in the anterior lobe on the injured side, and protruding into the median fissure. It contained about one ounce of pus. In such a case

as this, trephining would evidently have been useless; for although it was probable that there was pus within the cranium, yet its seat could not have been diagnosed, and the abscess could never have been reached.

Another case that was admitted into the Hospital, was that of a man who had received a large lacerated wound on the left side of the scalp in consequence of a fall. There was no injury to the bone, and the patient went on perfectly well until the seventy-seventh day, the wound cicatrizing. He was then suddenly seized with hemiplegia of the right side, from which he recovered partially by being bled; some twitching of the muscles, however, continuing. On the ninety-ninth day after the accident he became comatose, and was trephined by Mr. S. Cooper, but without relief, dying with symptoms of compression of the brain on the third day after the operation. On examination, thick yellow lymph was found, covering the whole of the upper surface of both hemispheres lying between the arachnoid and pia mater, and extending into the sulci between the convolutions. There was an abscess in the substance of the brain on the surface of the right hemisphere on the side opposite to the seat of injury. Here, though the symptoms were well marked, and the diagnosis as to the existence of pus correct, trephining was also useless, as the pus could not be evacuated. These cases serve to indicate the difficulties that surround any operation with the view of evacuating matter from within the cranium.

When, however, the symptoms of inflammation have been interrupted by an attack of rigors followed by compression, with detachment of the pericranium, or a puffy swelling of the scalp, or by the separation of the pericranium, and the exposure of yellow and dry bone, there can be little doubt that the surgeon, though bearing in mind the extreme uncertainty of the case, might be justified in trephining at the seat of local change or of injury, in the hope of finding pus deposited beneath the cranium, and thus giving the patient his only chance of life. And should it not be met with there, and the dura mater appear bulging, and without pulsation, an incision might even be made through this membrane, in the hope that the abscess being circumscribed the escape of the pus might be facilitated. Should this attempt fail, there are few surgeons who would have the hardihood to follow the example of Dupuytren, who plunged a bistoury into the substance of the brain, and thus luckily relieved the patient of an abscess in this situation. But yet even though pus be found under the cranium, between it and the dura mater, and is evacuated, the encephalitis will probably lead on to the patient's death. Mr. P. Hewett states very justly that the successful termination of a case of trephining for matter between the skull and dura mater, is all but unknown to surgeons of the present day.

INJURIES OF THE SCALP.

Contusions of the scalp from blows are of common occurrence, and present some peculiarities that deserve attention. However severe the contusion may be, it seldom happens that the scalp sloughs. This is evidently owing to the great vascularity and consequent active vitality of the integuments of the head. In many cases a contusion in this situation is followed by considerable extravasation of blood, raising up the scalp into a soft semi-fluctuating tumor. It occasionally happens, especially in blows on the heads of children, that this extravasation gives rise to the supposition that fracture exists, owing to the edge of the contusion feeling hard, whilst the centre is soft, apparently from the depression of the subjacent bone. In some cases, indeed, this deceptive feeling will occur without any extravasation of blood under the scalp, the depressed centre being due to the compression of the scalp by the blow that has been inflicted upon it. This I have seen occasionally in children in whom the scalp is soft and somewhat spongy.

The *treatment* of contusion of the scalp is very simple; the continuous appli-

cation of evaporating lotions being usually sufficient for the removal of all effusions. Under no circumstances should a puncture be made or the blood let out in any way. Contusions of the scalp in girls and young women have been known to be followed by severe neuralgic pains in the part struck. This affection is extremely rebellious to treatment, but in two cases which I have seen, after lasting for a considerable length of time, these symptoms gradually disappeared; in such cases as these, incisions down to the bone are said to have sometimes been beneficial.

It occasionally happens that bloody tumors of the scalp form in newly-born children, either from contusion of the head in consequence of the pressure to which it is subjected in its passage; or else by the bruising of obstetric instruments. These tumors, which are often of large size and fluctuating, are termed *cephalœmatomata*. They may occur in two situations, either between the aponeurotic structures of the scalp and the pericranium, or between this membrane and the skull itself.

The *sub-aponeurotic cephalœmatoma* is by far the most common variety of the affection. It usually forms a large soft fluctuating tumor, situated upon one of the parietal eminences, and having a somewhat indurated circumference. These tumors may usually be made to subside in a few days by the use of discutient lotions.

The *sub-pericranial cephalœmatoma* is an injury of extremely rare occurrence. But Zeller, Valleiz, and others have determined its existence. It appears as a fluctuating tumor, without discoloration of the scalp, but with a hard elevated circle around it, and a soft depressed centre, almost communicating the sensation of a hole in the cranium. Pressure, however, gives rise to no cerebral symptoms, and enables the surgeon to feel the osseous lamina at the bottom of the depression. These tumors are usually of small size, seldom larger than a walnut, and it not uncommenly happens that they are multiple. It is worthy of note, however, that each tumor is always confined to a separate bone, never passing beyond the sutures, where the adhesions are the strongest between the pericranium and the subjacent osseous structure. This affection is said to be most frequently met with in children born in first confinements, and is more common in boys than in girls; according to Bouchard in the proportion of thirty-four to nine.

The pathology of this affection has been studied by Valleix. This surgeon found that the pericranium was separated from the bone by an extravasation of blood, and that both bone and pericranium were covered with plastic matter, but otherwise healthy. He also found that the hard circle surrounding the depression was formed by a deposit of osseous and plastic matter which bounded the extravasation. This deposit was effected in such a way that on a transverse section being made, the inner wall was found nearly perpendicular, whilst the outer sloped down upon the cranium, thus giving a cratiform appearance to the margin of the tumor. The treatment of this affection must be conducted on precisely the same principles as that of the other forms of scalp extravasated.

Wounds of the scalp are of very common occurrence, and are more serious than corresponding injuries elsewhere, especially so when occurring in persons about the middle period of life, and of unhealthy or broken constitutions. It is not only that these injuries are more likely to be followed by erysipelas than those of other parts of the body, but it is also to the great tendency to the propagation of inflammatory mischief inwards to the encephalon, and to the complication of cerebral mischief so often accompanying comparatively slight injuries of the scalp, that these accidents owe much of their serious and often fatal character. But though there be this danger to life in scalp injuries, there is comparatively little risk to the scalp itself; the abundant supply of blood it receives from closely subjacent arteries, and its consequent great vitality, is the reason why sloughing so seldom occurs, even though the part be much bruised and seriously lacerated.

The *treatment* of wounds of the scalp necessarily varies somewhat according to the nature of the injury. If this be a simple cut it will be sufficient, after shaving the parts around and cleansing its interior, to bring it together with a strip or two of adhesive plaster, and to dress it as lightly as possible. In these, as in all other cases of injury of the head, especial attention should be paid to the state of the brain, for however slight the external wound may be, serious cerebral mischief may have been occasioned; or, at all events, the same blow that has caused the cut in the scalp may have given rise to such functional derangement of the brain as may eventually lead to the worst forms of traumatic encephalitis.

It more frequently happens that the scalp is bruised and lacerated as well as wounded, and very commonly that a large flap of integument is stripped off the cranium, and is thrown down over the face or ear, so as to denude the bones. In these cases, advantage is taken of the great vitality of the scalp. However extensively contused or lacerated this may be; however much it may be begrimed with dirt; it is a golden rule in surgery not to cut any portion of it away, but after shaving the head and ligaturing any bleeding vessels, to wash and clean it thoroughly, and replace it in its proper position. Here it must be retained by the support of a few strips of plaster, or by the application of a suture or two at the points of greatest traction. If the edges do not come properly together a piece of water-dressing must be applied, but the head must be kept cool, and as little bandaging and plastering had recourse to as possible. The patient should be freely purged and kept perfectly at rest on rather a low diet, any cerebral symptoms that occur being treated in accordance with the principles laid down in discussing traumatic affections of the brain. In this way union will very probably take place through the greater portion of the injured surface; should it not do so, however, or should any part slough, granulations spring up and reparative action goes on with surprising rapidity. If matter form beneath the aponeurosis of the occipito-frontalis muscle, bagging must be prevented by early counter-openings, and by the employment of compression in proper directions. The pus has a special tendency to gravitate into the upper eyelid whenever suppuration takes place beneath the frontal portion of the muscle, and here the counter-opening may be conveniently made.

When the skull is extensively denuded in consequence of the scalp with the subjacent pericranium being stripped off, we must not necessarily expect that necrosis and exfoliation of the exposed bone will occur. In cases such as these, the flap must be laid down on the denuded osseous surface, to which it may possibly contract adhesion. Should it not do so, however, the exposed portions of the cranium may inflame, plastic matter be thrown out, and thus granulations springing up, a covering be formed to the bone.

INJURIES OF THE SKULL.

Contusion of the cranial bones occurring in injuries of the head, especially complicated with wound of the scalp, is often a serious condition, if it be followed by suppuration in the diploe of the bone, and abscess between it and the dura mater, or even under this membrane.

Fracture and other injuries of the bones of the skull possess great interest, not so much from the lesion of the bone itself, as from its frequent complication with injury of the brain and its membranes. This cerebral complication may either be produced by direct injury occasioned by the fragments of the fractured bone compressing or wounding the brain, or it may be the result of the same violence that occasions the fracture concussing or lacerating the brain.

Fractures of the skull are invariably the result of external violence. This may act directly in breaking and splintering the part struck, the fissures often extending to a considerable distance and detaching large portions of the cra-

nium; or, the violence may act in an indirect manner, producing the fracture either without being applied immediately to the cranium, or else at an opposite part of the skull to that which is struck. Thus the base of the skull may be fractured by the shock communicated to it when a person, falling from a height, strikes the ground heavily with his feet. The other variety of indirect fracture, that in which the solution of continuity occurs at a point of the cranium opposite to that which has been struck, is the fracture by "contre-coup."

This kind of fracture has been described by some surgeons as of frequent occurrence, whilst it has been denied by others. There can, however, be no doubt that it does happen, though less commonly perhaps than is generally supposed. Every hospital surgeon must occasionally have seen unequivocal instances of it. For its occurrence several conditions are necessary. The skull must be struck over a large surface, as when a person falls with his head against the ground. If the blow alight on a thin portion of it, this will be directly fractured; but if a dense and strong part of the bone be struck, as the parietal eminence, or the lower part of the os frontis, the shock transmitted through the cranium generally will cause the thinnest and most brittle portions of the skull, though distant, to give way in preference to the stronger part on which the blow has immediately fallen. These fractures by contre-coup are most common at the base of the skull and are commonly much radiated. They are never depressed.

An ordinary, simple, or *undepressed fracture* of the skull consists in a fissure, sometimes single, at other times starred, extending often to a considerable distance through the bones, radiating sometimes across the skull, and at others completely detaching the upper from the lower, or the anterior from the posterior segment of the cranium. In some cases the fracture extends into one of the sutures, and in other instances, which, however, are very rare, the sutures are separated without any fracture.

These injuries usually occur from direct violence, but are also the only forms of fracture that happen by contre-coup. A simple fracture, such as this, gives rise to no signs by which its diagnosis can be effected. If, however, the scalp covering the injured bone has been wounded, its existence may be ascertained by running the finger-nail, or the end of a probe, over the exposed surface of the bone, or by seeing a fissure into which the blood sinks. In these simple undepressed fractures no special treatment is required to the fracture itself, the surgeon's whole attention being directed to the concomitant injury that may have been inflicted on the brain or scalp. Active precautionary measures should be adopted without delay, with the view of guarding against the occurrence of inflammation of the brain and its membrane, even though no symptoms have as yet declared themselves. So soon as the patient has recovered from the concussion, his head should be shaved, the ice-bladder applied, and blood freely taken away from the arm; the bowels should be well opened, and the room kept cool and quiet. The employment of free and repeated bleeding is, however, of more service than any other means, and should never be omitted.

The most serious, and indeed a very commonly fatal form of simple fracture of the skull, is that which extends through the *base of the cranium*. These injuries usually occur by falls from a height or blows upon the vertex or side of the head, producing a fracture which extends from the point struck across the base of the skull, often running through the petrous portion of the temporal bone or into the foramen ovale. They may also take place as the result of contre-coup, or by a person falling from a height on his head, and having the base of the skull broken in by the weight of the body projected against it. The great danger in these cases is the concomitant injury to the brain, either by its direct laceration or by the extravasation of blood upon it. Though most usually fatal, these injuries are not invariably so. Not only does it occasionally happen that patients with all those signs of fracture of the base of the skull, which

will immediately be described, are seen to make a complete recovery, but in the different museums, specimens illustrative of recovery after this accident may be met with. Thus, in the College of Surgeons' museum, there is the skull of a person who lived two years after a fracture at its base.

The occurrence of fracture of the base of the skull is very commonly suspected when symptoms indicative of serious injury to the brain speedily follow a severe blow upon the head, owing to the greater liability to injury of those parts of the nervous centre that are most important to life, in these than in other fractures of the skull; the same violence that occasions the fracture injuring the contiguous portions of brain, or lacerating some of the large venous sinuses about the base of the skull, giving rise to abundant extravasation of blood. These symptoms are necessarily in the highest degree equivocal, and much anxiety has been evinced by surgeons to discover some special sign by which the occurrence of this particular fracture may be determined.

There are two signs, the occurrence of which leads to strong presumptive evidence in favor of the existence of this kind of fracture. These are, 1st, the escape of blood, and 2ndly, of a serous fluid from the ears, and occasionally from other parts in connection with the base of the skull.

The occurrence of *bleeding from the ears* after an injury of the head cannot by itself be considered a sign of much importance, as it may arise from any violence by which the tympanum is ruptured without the skull being necessarily fractured. If, however, the hemorrhage be considerable and continuous, and more especially if it be associated with other symptoms indicative of serious mischief within the head, and if it have been occasioned by a degree of violence sufficient to fracture the skull, we may look upon its supervention as a strong presumption that the petrous portion of the temporal bone has been fractured, and perhaps one of the venous sinuses in its neighborhood torn.

Bleeding from the nose may of course arise from any injury applied to this organ without the skull being implicated; but yet in some cases of fracture of the skull the hemorrhage proceeds from the interior of the cranium, the blood escaping through a fissure in the roof of the nasal fossæ. In a patient of mine who died five weeks after an injury of the head, accompanied by much bleeding from the nose, a fracture by a contre-coup was found extending across one orbital plate of the frontal bone, and separating its articulation with the ethmoid. In this case the nature of the injury was suspected from the fact of the nose itself having been uninjured by the blow, although the hemorrhage from it was very considerable and continuous.

The *discharge of a thin watery fluid* from the interior of the cranium is of rare occurrence, but when it happens may be considered as pathognomonic of fracture of the base of the skull. Indeed it is the most certain sign of this injury that we possess. This discharge usually takes place through the ear: but it may occur from the nose, of which I have seen one instance, and Robert mentions another. Still more rarely it takes place from a wound in the scalp communicating with the fracture, percolating through this, and so being poured out externally. The only case of this kind with which I am acquainted is one which was communicated to me by one of the pupils of the College, as occurring at the Penrhyn Infirmary a few years ago. In this case a boy received a wound on the back of the head, with depressed and comminuted fracture of the skull. On the nineteenth day after the receipt of the injury a large quantity of serous fluid began to discharge through the wound, and continued to do so profusely until his death from coma four days later.

There would consequently appear to be three situations: the ear, the nose, and a wound on the head, from which this discharge has been observed. It is an exceedingly valuable though most serious sign; and Robert, who has investigated this phenomenon with much closeness, states, that the cases in which it happens always terminate fatally. This, however, is an error; for at least one

case has occurred at the University College Hospital, in which the patient recovered, although a large quantity of fluid was discharged from the ear. It is usually associated with symptoms indicative of serious injury to the base of the brain, but to this there are also exceptions, for I have seen it take place in cases of injury of the head, unaccompanied by any severe cerebral symptoms. Most generally it occurs in young people. Robert says that it does so invariably, but in one of the cases that I have witnessed the patient was fifty-eight years of age.

The quantity of fluid that is thus discharged is always very considerable, the pillow usually becoming soaked by it, and thus first attracting attention to it. It is often necessary to keep a piece of sponge or a pledget of lint against the ear, in order to prevent the fluid wetting the patient, as it trickles out, and if a cup be so placed as to collect it, an ounce or two will speedily accumulate. Laugier states that he has seen a tumblerful discharged in a short time, and as much as twenty ounces have been known to be poured out in three days. The flow is usually continuous for several days, and then ceases. It is remarkable that the hearing does not always appear to be destroyed in the ear from which the discharge takes place.

The nature and the source of this discharge have been particularly investigated by Laugier, Chassaignac, Robert, and Guthrie. Its physical and chemical characters are those of a perfectly clear, limpid, and watery fluid, containing a considerable quantity of the chloride of sodium, with a little albumen in solution. It is not coagulable by heat or nitric acid.

The source of this discharge has not as yet been investigated with all the attention that its importance requires. Laugier believed it to be the serum of the blood filtering through a crack in the petrous portion of the temporal bone, and so out through the ruptured tympanum. This explanation, however, is evidently not correct, for not only is blood extravasated in the living body incapable of this species of rapid and complete filtration, but the chemical composition of the fluid, which differs altogether from that of the serum of the blood, in containing a mere trace of albumen and double the quantity of chloride of sodium, is incompatible with this supposition. By others it has been supposed that the fluid was furnished by the internal ear, being a continuous discharge of the liquor cotunnii, but its large quantity, and, above all, the fact of its occasionally escaping through the nose, establishes the fallacy of this explanation. Again, it has been supposed, but without sufficient evidence, that the cavity of the arachnoid furnished this secretion. I think with Robert that there can be little doubt that this discharge consists of the cerebro-spinal fluid, for not only does it resemble in appearance and chemical composition this liquid, but there is no other source within the cranium that can yield with equal rapidity so large a quantity of fluid; experiment having shown that the cerebro-spinal liquid is rapidly reproduced after its evacuation. In order that this be discharged, it is necessary that the membranes of the brain be ruptured opposite the outlet by which it is poured forth. This has actually been ascertained to be the case in carefully conducted dissections of injuries of the head in which this symptom has occurred. When it is discharged through the ear it is not improbable, as Bérard has remarked, that the laceration extends through the cul-de-sac of the arachnoid, which is prolonged around the auditory nerve in the internal auditory canal. When it is poured out through the nose, it has probably been by the fracture extending through the sphenoidal sinuses.

The *treatment* of fractures of the base of the skull must be conducted on those general principles that guide us in the management of simple fractures; no special means can be had recourse to, and in the great majority of cases a fatal termination speedily ensues.

It occasionally though very rarely happens that in consequence of a blow a portion of the cranium is depressed without being fractured, and even without

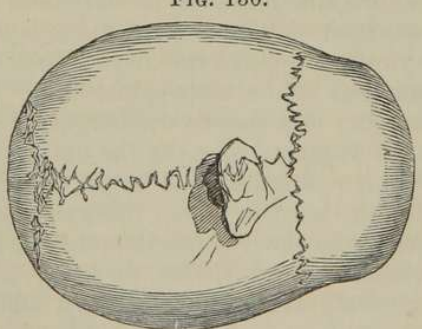
any serious symptoms occurring. Thus Green mentions a case in which the bowl of a dessert-spoon might be laid in the hollow produced in the skull by a blow, and no symptoms resulted. These depressions without fracture can, however, only occur in children whose crania are soft and yielding. In adults they cannot happen without the occurrence of partial or incomplete fracture. It must be borne in mind, however, that the apparent depression produced by an extravasation under the scalp may simulate this injury very closely, and a very experienced surgeon may sometimes under these circumstances be deceived, and be induced to cut down on a suspected fracture when in reality none exists.

Depressed fractures of the skull may either be simple, without wound of the scalp, compound, or comminuted. In the majority of cases, whether the fracture be simple or compound, there is comminution of the injured portion of bone; the fragments being perhaps driven into the brain.

Depressed fractures of the skull present many varieties; sometimes, though very rarely, the external table alone is depressed. This is especially the case over the frontal sinuses, where it may be broken in, as I have seen happen from the kick of a horse, without the inner table being splintered, or any bad consequences ensuing. Much more commonly, however, the inner table is driven in with comparatively little injury to the outer one; it has, indeed, been stated that a portion of the inner table may be depressed without there being any fracture of the external one; this, however, can scarcely occur, though it may happen with but a very trifling fissure of the outer table.

In all ordinary depressed fractures the internal table is splintered to a greater extent than the external one. This is especially the case when the fracture is the result of gun-shot injury, or when it has been occasioned by blows with a pointed weapon, as the end of a pick, or a large nail, or the sharp angle of a brick. In these fractures, which constitute the dangerous variety termed *punctured*, the outer table may be merely perforated or fissured, whilst the inner one is extensively splintered. This splintering of the inner lamina of the skull to a greater extent than the outer one has attracted much attention, being of considerable practical moment, and is usually said to be owing to its being more brittle than the external table. This, however, I do not consider to be the only cause. I should rather attribute it to the direction of the fracturing force from without inwards, causing a certain loss of momentum in passing through the outer table; and that thus the inner table is splintered more widely than the outer one, for the same reason that the aperture of exit made by a bullet is larger than that of entry. If this be the true explanation, the reverse ought to hold good if the force be applied in the opposite direction. It is very seldom that we have an opportunity of examining such a case; but a few years ago a man was brought to the hospital who had committed suicide by discharging a pistol into his mouth and upwards through the brain. The bullet had perforated the palate and passed out at the upper part of the cranium, near the vertex (fig. 130). On examining the state of the bones, it was found that the outer table of the skull was splintered to a considerably greater extent than the inner one, showing clearly the influence of the *direction* of the fracturing force. I have since found by experiment on the dead body, that this is most generally the case when the blow is struck from the inside of the skull outwards.

Fig. 130.



It occasionally happens as the result of sabre or hatchet cuts on the head, that a kind of longitudinal punctured fracture occurs, in which the outer table

is merely notched, whilst the inner one is splintered along the whole line of blow. In other cases, again, a portion of the cranium is completely sliced off, hanging down in a flap of the scalp, and exposing the brain or its membranes.

The *symptoms* of a depressed fracture of the skull are of two kinds: those that are dependent upon the injury to the bone, and those that result from the concomitant compression or laceration of the brain.

When the scalp is not wounded, the depression may sometimes be felt; but very commonly it is masked by extravasation of blood about it, and the surgeon is only led to suspect its existence by the continuance of symptoms of compression from the time of the injury. In all cases of doubt when these symptoms exist, an incision should be made through the scalp at the seat of injury, and the state of the skull examined. When there is a wound in the scalp communicating with the fracture, the surgeon detects at once the existence of depression and comminution by examining the bone with his finger through the wound. Although symptoms of compression almost invariably exist from the first in cases of depressed fracture, yet it occasionally happens that no cerebral disturbance comes on for some days, even though the injury done be very extensive. A man, twenty-four years of age, was admitted into University College Hospital under Mr. Morton. He had been struck on the forehead with the sharp edge of a quoit. The frontal bone was extensively comminuted, twelve fragments being removed, and the dura mater being exposed to a considerable extent; yet no bad symptoms occurred until the ninth day, when inflammation of the brain and its membranes set in, and he speedily died.

In other cases again, more especially in children and young persons, in whom the bones are soft and yielding, depression with fracture may exist to a considerable extent, and no symptom whatever of compression be produced at the time or at any subsequent period,—the patient living with a portion of his skull permanently beaten in.

The great danger in these cases of depressed and comminuted fracture arises, however, not only from the compression of the brain, but from the rapidity with which inflammation is set up in consequence of the sharp fragments wounding and irritating the membranes and brain. Indeed, a wound of the dura mater, however slight, is a most dangerous complication, and one that is not often recovered from. It is not, however, necessarily fatal; I have lately had a case under my care, in which, although this occurrence had taken place in consequence of depressed fracture, the patient made a good recovery. This is more especially the case in those injuries in which the inner table is extensively splintered, as in the different forms of punctured fracture. In these cases there may be no signs of compression, but inflammation speedily sets in, and certainly proves fatal if the causes of irritation, the sharp spiculæ, be allowed to remain in contact with the dura mater. This membrane becomes sloughy and coated with a thick deposit of plastic matter, whilst the usual evidences of encephalitis are found in the other membranes and the brain.

The *treatment* of a depressed and comminuted fracture of the skull varies according to the nature and extent of the accident.

If there be no wound in the scalp, but the occurrence of symptoms of compression and the existence of some irregularity of the cranium at the seat of injury lead the surgeon to suspect a depressed fracture, he should make a crucial or T-shaped incision down upon the part in order to examine the bone, and if this be found depressed to elevate or remove it.

If the scalp be already wounded all that need be done to ascertain the nature of the fracture, is to pass the finger into the wound and thus examine the bone. If any fragments be found lying loose they should be picked out, as their presence can only excite injurious irritation; any bone that is driven below its level must be raised, and, if completely detached, removed.

In order to raise these depressed portions of bone, it is in many cases only

necessary to introduce the point of an elevator underneath the fragment, and using the instrument as a lever, elevate it into position. If there be not an aperture sufficiently large for the introduction of the elevator, one must be made by sawing out an angle of bone at a convenient spot by means of a Hey's saw or bone forceps. In this way sufficient space may usually be gained without the necessity of applying the trephine. If, however, the inner table be splintered to a considerable extent, or, if there be no convenient angle that can be removed, the trephine must be applied in such a way that at least half its circle is situated upon the edge that overhangs the depressed bone; the surgeon sawing out by means of this instrument a portion of the undepressed cranium, in order that he may more conveniently get at the fragment. After a half circle of bone has been removed in this way, the depressed splinters may be taken out; a Hey's saw still being occasionally required before the whole can be removed; the flaps of scalp should then be laid down, a suture or two applied, and water-dressing put over the wound. Rigorous antiphlogistic treatment must then be adopted with the view of preventing or removing the inflammatory symptoms which set in.

In all cases that partake of the nature of a *punctured* fracture, those in which there is but slight injury of the external table, but considerable splintering and depression of the inner one, the trephine must be applied on different principles to those that guide us in its use in ordinary depressed fractures. In the punctured fracture it is applied, not to remove symptoms of compression which, in all probability, may not exist; but with the view of preventing inflammation, which would to a certainty be set up if the splinters of the inner table were allowed to continue irritating the membranes and brain. Hence it is a rule in surgery, in all cases of punctured fracture, to apply the trephine at once, so as to prevent those injurious after-consequences, which must otherwise necessarily result. In these cases a trephine with a large crown should be used, and the circle of injured bone itself must be sawn out.

Should, however, the use of the trephine have been delayed in these cases until inflammatory action have been set up, the instrument may still be applied with advantage. Some years ago, a boy was admitted into University College Hospital, on the sixteenth day after having been struck on the side of the head by a large nail, which projected from a door that fell upon him. No symptoms of any kind had occurred until the eleventh day after the accident, when he became dull and lost his appetite; on the sixteenth day, that of his admission, he had suddenly become drowsy and delirious, but answered rationally when spoken to, and complained of pain in the head. The pupils were dilated, the skin hot, and the pulse quick. On examination a small round aperture from which some fetid pus exuded was discovered on the right parietal eminence. On introducing a probe, which the hole just admitted, some rough bone could be felt. Mr. S. Cooper immediately trephined the boy, removing a circle of bone including the small aperture The inner table corresponding to this was found splintered to some extent, and the dura mater was seen to be thickened and inflamed, but the patient recovered without a bad symptom.

In those rare cases in which there is a depressed fracture, without symptoms of compression, or even a wound of the scalp, the line of practice is somewhat unsettled, as to whether the depressed portion of bone should be left where it is, or an attempt be made to elevate it. Sir A. Cooper, Abernethy, and Dupuytren advise that, if it give rise to no symptoms of compression, it is better not to interfere with it; and there are several cases on record of patients who have recovered in whom this course was adopted, the depression continuing permanent. I am acquainted with a gentleman upwards of fifty years of age who has a depression in the parietal bone as large as the bowl of a table spoon, the result of a fracture from a fall from a horse when a lad, and from which no inconvenience has resulted. I think, however, that this expectant practice

should not be followed too implicitly, but that we must be guided by the circumstances of the particular case. If the depression be pretty uniform, of inconsiderable depth, and occupy some extent of cranium, it may be better doubtless to follow the practice of these great surgeons, and to wait for symptoms of compression manifesting themselves before we interfere. If, however, the depression be sharp, and comparatively small in extent, we may reasonably suspect the existence of considerable splintering of the inner table; and here the safer plan would be, even in the absence of all symptoms of compression, to trephine for the same reason that we do so in punctured fracture — the prevention of inflammatory irritation.

The sooner this is done the better. Danger does not arise from early operations, but from delay. The presence of depressed and spiculated fragments pressing into the dura mater must infallibly and speedily induce encephalitis. I have several times trephined under such circumstances as these with success, and have never had occasion to regret doing so. Even though several days have elapsed and inflammation has set in, the proper treatment will be to remove the depressed and splintered bone, and thus give the patient his only chance, a slender one, it is true, of recovery. Under such adverse circumstances the patient may, however, be saved.

A man was admitted under Mr. Liston for a long depressed fracture on the side of the head, received by the blow of a brickbat; though no sign of compression existed, yet symptoms of cerebral inflammation were speedily set up, and Mr. Liston trephined him on the fourth day after the accident; the man, who was perfectly conscious, walking into the operating theatre. A considerable splintering of the inner table was found, the fragments of which were removed. The dura mater having been punctured by one of the spiculæ of bone, diffuse suppuration of the membranes of the brain set in, and the patient died in a few days. In this case, however, the necessity for early trephining was clearly indicated, notwithstanding the absence of any symptom of compression.

When a depressed fracture of the skull is complicated with a fracture or other injury of the spinal column, it is sometimes difficult to determine how much of the symptoms may be due to one accident, and what proportion to the other. In such a case as this, however, we should, I think, treat the depressed fracture irrespective of the vertebral injury, thus giving the patient a chance of recovery, of prolongation of life, or, at least, of return of consciousness before death. A man was admitted under my care into the hospital, with depressed fracture of the left parietal bone, and injury of the cervical spine, the precise nature of which could not be accurately determined. He was in a state of complete coma and paralysis. I trephined the skull and elevated the depressed portion of bone; he recovered his consciousness to a great degree, but died in a few days, apparently from the injury to the spine. On examination after death we found a fracture of the fifth cervical vertebra.

WOUNDS OF THE BRAIN AND ITS MEMBRANES.

Wounds of the brain and its membranes are frequent in injuries of the head, and constitute one of the most important complications of these accidents. The extent of injury inflicted upon the cerebral substance has wide limits, from slight laceration without exposure, to denudation of the brain, disintegration, and escape of large portions of its pulp.

Injury to the brain may be occasioned in various ways. The simplest form is that, perhaps, which is not unfrequently met with in undepressed fracture of the skull, and sometimes happens without fracture, from simple concussion or commotion of the head, laceration of the cerebral substance occurring either under the seat of injury, or more frequently at a distant or opposite point, by a kind of contre-coup. This *laceration of the brain by contre-coup* is by no means

of unfrequent occurrence. I have seen many striking instances of it, and have found it to be one of the commonest causes of death in simple fractures of the skull.

Laceration of the brain by contre-coup is attended by much extravasation of blood; and after death the brain substance is found mixed up with coagula, and forming a soft, pulpy, bloody mass. This accident may occur without any fracture of the skull, or external sign of serious injury, and usually results from falls upon the back or side of the head, often from an inconsiderable height, as in a person slipping suddenly up in frosty weather and striking his head on the pavement; when the anterior or opposite portions of the hemispheres of the brain to that struck will be found in the condition just described.

The brain and its membranes are often lacerated by the sharp spiculæ of a depressed fracture, which may penetrate to a considerable depth in its substance. And, lastly, the injury may be occasioned by foreign bodies, such as bullets traversing or lodging in the head, or by stabs and punctures through the thinner portions of the skull, especially the orbital plate of the frontal bone. In this way pieces of stick, tobacco-pipe, the point of a knife, or a scissor-blade, may puncture the anterior part of the brain.

The *symptoms* of wound or laceration of the brain vary greatly according to the age of the patient, the seat of injury, and other conditions, which cannot very readily be determined. If the injury implicate those portions of the nervous centre at the base of the brain, the integrity of which is necessary for the proper maintenance of the respiratory act, immediate death must necessarily ensue. If, however, portions of this organ that are less vital, as the anterior lobes and upper part of the hemispheres, are injured, but very slight symptoms may occur; and in some cases, indeed, there is no positive indication by which this injury of the cerebral substance can be determined, except by its exposure and escape through the external wound. Hence it is that even the worst injuries of the head are rarely immediately fatal, the patient being seldom killed outright unless the medulla oblongata be wounded. Children, especially, have been known to bear extensive injuries of the brain, and even the loss of a considerable quantity of cerebral matter without any very serious effects, either immediate, or remote; and it is by no means of uncommon occurrence to see them live for several days with an extent of injury to the brain, that would rapidly have proved fatal to an adult. Twitchings of the muscles and epileptiform fits are commonly met with when the brain is lacerated, and these complicating stertor, or alternating with it, indicate the nature of the mischief.

Foreign bodies even of large size and considerable weight have been lodged for a considerable time within the cranium, in contact with the brain, without occasioning death. Thus Hennen states that he has seen five cases in which bullets were lodged within the cranium, that did not prove immediately fatal. Dr. Cunningham relates the case of a boy who lived for twenty-four days with the breech of a pistol, weighing nine drachms, lying on the tentorium, and resting against the occipital bone. Dr. O'Callaghan has recorded the remarkable case of an officer who lived for about seven years with the breech of a fowling-piece, weighing three ounces, lodged in the forehead; the right hemisphere of the brain resting on the flat part, from which it was only separated by false membrane.

[Perhaps the most remarkable case on record of severe injury of the head, terminating in recovery, is the one reported by Professor Bigelow, of Harvard University (see American Journal of the Medical Sciences for July, 1850), in which, by the premature explosion of a blast, a tamping-iron, three feet seven inches in length, one and a quarter inches in diameter, and weighing thirteen and a quarter pounds, traversed the skull. "The wound thus received was oblique, traversing the cranium in a straight line from the angle of the lower jaw on one side to the centre of the frontal bone above, near the sagittal suture,

where the missile emerged; and the iron thus forcibly thrown into the air was picked up at a distance of some rods from the patient, smeared with brains and blood. From this extraordinary lesion, the patient has quite recovered in his faculties of body and mind, with the loss only of the sight of the injured eye."]

From the great variety of effects produced by these injuries, it must be evident that there can be no one set of symptoms indicative of wound of the brain, provided there be no external wound through which the condition of the cerebral substance can be ascertained. In those cases in which this does not exist, we can at most only suspect laceration, if we find that the ordinary symptoms of compression or concussion are associated with signs that do not usually occur in those conditions when uncomplicated; such as the contraction of one pupil, the dilatation of the other, and perhaps an alternation of these states with twitchings of the limbs, hemiplegia of one side, or paralysis of an arm, and of the opposite leg, with perhaps involuntary spasmodic movements of the other members. These irregular symptoms, when accompanied by much coldness of the surface, slowness of pulse, and depression of vital power, may generally be looked upon as indicative of cerebral laceration.

Wounds of the dura mater are always liable to be followed by symptoms of the most serious character, and are seldom recovered from; diffuse meningitis, the formation of pus within the cranium usually occurring and speedily terminating the patient's existence. I have, however, seen recovery follow this accident.

Wounds of the brain may prove fatal, either at once by the injury of the respiratory tract; in the course of a few hours, by the continuance of shock, and by the extravasation of blood within the cranium; at a later period, by the occurrence of encephalitis and its consequences; or more remotely still, by the supervention of paralysis and other ulterior effects of injury of the nervous system.

In the *treatment* of injuries of the brain, little can be done after the system has rallied from the shock, beyond attention to strict antiphlogistic treatment, though this need not be of a very active kind. In these cases, indeed, as much should be left to nature as possible, the surgeon merely removing all sources of irritation and excitement from his patient, and applying simple local dressings.

If any foreign body be lodged within the cranium, it must of course be removed, if possible. This may be done if it be situated near the external wound, or fixed in the bones, but if it have penetrated deeply into the substance of the brain, and have got beyond the limits of the external wound, it would be perhaps more dangerous to trephine the skull on the chance of reaching it, or in any other way to go in search of it, than to leave it where it is.

Fungus or hernia cerebri. — In those cases in which a laceration of the brain and dura mater communicates with a fracture of the skull, it is occasionally found, more particularly in children, that a bloody, fungous-looking mass of cerebral matter protrudes from the wound. This tumor increases pretty rapidly, pulsates synchronously with the brain, and may shortly attain the size of a hen's egg, or even become larger. It is composed of softened and disintegrated cerebral matter, infiltrated with lymph and blood. This softening of the brain, with red discoloration of its substance, extends for some little distance under the base of the tumor. The mental condition of the patient laboring under this affection is in many cases not much disturbed at first, there being merely some degree of cerebral irritation. Speedily, however, stupor comes on, and death eventually occurs from coma.

The treatment of this complication of fractures of the skull is commonly extremely unsatisfactory. If the tumor be shaved off, as usually recommended, it generally sprouts again until the patient is destroyed by irritation and coma

conjoined. In some fortunate cases, however, the removal of the tumor is not followed by its reproduction. All that can be done is to slice off the growth on a level with the brain; to apply a pledget of wet lint, and a compress and bandage over the part, thus allowing it to granulate and the wound to cicatrize.

EXTRAVASATION OF BLOOD WITHIN THE SKULL

Commonly occurs in all injuries of the head accompanied by laceration of the brain, and in many of those in which the skull is fractured without that organ being injured. Indeed, when we reflect on the great vascularity of the parts within the cranium, the large sinuses, the numerous arteries, that ramify both within the bones and at the base of the brain, and the close vascular network extended over the surface of this organ, we can easily understand that extravasation of blood is one of the most frequent complications of these injuries and a common cause of death, when they terminate fatally at an early period after their occurrence.

Extravasation of blood within the cranium may take place either from the fracture tearing across one of the meningeal arteries distributed on the inside of the skull, or by a fragment of bone wounding a sinus, or the vascular network on the surface of the brain, or it may proceed from laceration of this organ breaking down its capillary structure. In other cases again, as in gun-shot wounds, the hemorrhage may occur as a consequence of the wound of the vessels by the bullet or other foreign body.

The extravasation may occur in four situations. 1st. Between the dura mater and the skull, where it is most commonly met with; 2d. Within the cavity of the arachnoid; 3d. Upon the surface of the brain; or, 4th, within its substance and its ventricles. It is usually most considerable when poured out upon the dura mater, or within the cavity of the arachnoid at the base of the brain. It is in smallest quantity immediately on the surface of that organ, or within its substance. It is, however, seldom found in the latter situation as the result of violence, without being also met with more superficially. The quantity effused in any one case seldom exceeds four ounces; and when in large quantity, such as this, it usually proceeds from rupture of the meningeal artery.

Extravasation of blood is one of the most frequent causes of death in injuries of the head, by inducing pressure on the brain, and coma. The blood that is extravasated usually coagulates into a firm granular clot. There can be no doubt, however, that extravasation of blood into the membranes of the brain frequently occurs without being attended by fatal consequences. The blood that is so extravasated may undergo various changes. It would appear that the extravasated blood may 1st, be absorbed entirely; 2d, that the serous portions and coloring matter may be removed, leaving a fibrinous buff-colored clot, which may eventually become organized; and 3d, the exterior of the clot may become consolidated, whilst the interior contains fluid and disintegrated blood.

The *symptoms* of extravasation are often by no means very clear; being those of compression associated in the early stages of the case with symptoms indicative of laceration of the brain, and, at a later period, with those of encephalitis. Putting out of consideration, however, these complications, the more special symptoms of compression from extravasated blood may occur in two ways. In the first variety there are three distinct stages, viz. concussion, a return and some continuance of consciousness, and then coma gradually supervening. The patient is concussed or stunned, as usual after the receipt of a blow on the head; from this he quickly rallies, and then symptoms of compression set in, and gradually increase in intensity. He becomes drowsy and dull, with a slow and laboring pulse, dilated and sluggish pupils, and a tendency to slow respiration; as the compression increases, complete stupor at length comes on, with

stertor in breathing, and there is either general paralysis, or hemiplegia of the side opposite to the seat of injury.

When the symptoms run this regular course it is probable that the extravasation results from injury of one of the meningeal arteries, or large venous sinuses; that the extravasation is confined to the membranes of the brain, and that there is no laceration of the substance of this organ. This may be termed the *meningeal extravasation;* and most commonly occurs from rupture of the middle meningeal artery, which, from its situation in a deep canal in the parietal bone, is peculiarly apt to be torn in injuries of the side of the skull.

More commonly, however, it happens that the patient never recovers his consciousness after having been stunned, the symptoms of concussion speedily passing into those of compression. In these cases the paralysis is commonly incomplete and associated with twitchings of the limbs or convulsive movements of the body generally, and much restlessness with incoherent muttering: there is sometimes contraction, at others dilatation of the pupils, and it occasionally happens that squinting is observed. It is especially when there are convulsions, that the pupils are observed to be in different conditions; and I have most frequently noticed the pupil dilated on the side that is most convulsed. In these cases the extravasation is probably connected with, and dependent on, laceration or disorganization of a portion of the brain, and may consequently be termed the *cerebral extravasation.*

The *diagnosis* of these two forms of extravasation from one another is important, as it is only in the meningeal that any operative procedure can be successfully undertaken, and it may usually readily be effected by attention to the symptoms just detailed.

The *diagnosis* of the compression from extravasation, and that from depressed bone or inflammatory effusions within the cranium, is easily made. In the case of the depressed fracture, we have symptoms of compression continuing uninterruptedly from the very first, and proper examination of the cranium will always lead to the detection of the injured bone. When inflammatory effusions, whether of pus, lymph, or serum, exercise undue pressure upon the brain, we find that the signs of compression have been preceded by symptoms of cerebral inflammation, and that they are accompanied by a good deal of pyrexia, by quick pulse and hot skin; the character of the scalp wound likewise, and the separation of the dura mater when pus is effused, enable us to distinguish this condition from those cases in which the pressure is the result of extravasated blood.

From apoplexy, the diagnosis is not always easily made, more particularly when there is no evidence that the head has been injured. A man was brought to University College Hospital in a state of profound coma, in which condition he had been found lying in the street. There was no evidence of injury about the head, beyond a bruise, which had probably been received when he fell. The case, which was supposed to be one of apoplexy, and treated accordingly, proved fatal in a few hours. On examination after death the skull was found fractured, but not depressed. On the opposite side to the bruise and fracture, a coagulum weighing nearly four ounces and compressing the brain, lay between the dura mater and bone. In such a case as this, it is evident that the history can alone afford a clue to its true nature. Even when the head has been injured it is not always easy. A man was admitted under my care, comatose. A fortnight previously he had been struck on the left side of the head behind the ear. He was stunned, bled freely from the left ear, but then got tolerably well, and went about his avocations as usual until the day before his admission, when he became suddenly comatose. There was stertor, quick pulse, some heat of head, the right pupil natural, the left, contracted. He was treated antiphlogistically, but died on the third day. On examination, a fracture on the left side of the skull was found extending into the left internal meatus; on the

right side of the head immediately opposite the fracture and the seat of injury, a large coagulum was found in the cavity of the arachnoid, with some serous exudation about it. Here was a meningeal extravasation, the result of contre-coup, existing without symptoms for fourteen days, and then proving rather suddenly fatal by the supervention of inflammation.

From the insensibility of drunkenness the coma resulting from injuries of the head may usually be distinguished, by the absence of local mischief, by the smell of the breath, and by the face of the drunkard being flushed and turgid instead of pale, as in a person who is suffering from the effects of a severe injury. When a drunken person has met with an injury of the head and is insensible, he should always be carefully watched, however slight the injury may appear to be, until time has elapsed sufficient for him to recover from his drunken fit, as it is impossible to say whether the stupor be the result of intoxication, or of mischief within the cranium, and I have known cases sent away from hospitals as drunk, when in reality the stupor was occasioned by depressed bone.

The *treatment* of extravasation of blood may be conducted on two principles, either by means of general and local antiphlogistic measures, having for their object the arrest of further hemorrhage, the promotion of absorption, and the subdual of inflammatory action; or else by the application of the trephine, with the view of allowing the escape of the effused blood.

The line of treatment to be adopted should, I think, have reference to the character of the symptoms. When these indicate the *cerebral* form of extravasation, trephining can be of little service, and we must content ourselves with general antiphlogistics; but when the extravasation seems to be *meningeal*, then an attempt might be successfully made to evacuate the extravasated blood.

Although *the operation of trephining* in cases of extravasation was formerly much in vogue, it is seldom had recourse to by modern surgeons, and is only proper in the meningeal form of extravasation. It is very true that if it could be ascertained without doubt that the extravasation is not only of the meningeal character, but that it is so situated that the blood may be removed through the trephine aperture, and that there were no other serious injury to the brain or skull, the operation should at once be performed. And doubtless the case occasionally happens in which, from the situation of the blow, and perhaps of a capillary fissure over the course of the middle meningeal artery, the gradual supervention of signs of compression, after an interval of consciousness, and the occurrence of hemiplegia on the side opposite to that which has been struck, the surgeon is warranted in making an aperture in the skull at the seat of injury, in order to remove the blood that has been poured out, and to arrest its further effusion. But the instances in which this assemblage of symptoms could exist, with sufficient precision to justify an operation, are excessively rare. Out of some hundred cases of serious and fatal injury of the head that have been admitted into University College Hospital during the last fifteen years, in one case only, I believe, has it been found advisable to have recourse to trephining for the removal of extravasated blood. The case to which I refer was that of a man admitted comatose three days after an injury of the head occasioned by the fall from a cab. There were no serious symptoms for some hours after the accident, but then stupor gradually came on, amounting at last to complete coma. On examination, a bruise of the scalp was found on the left temple: through this I made an incision, and finding a starred fracture over the sinus of the middle meningeal artery, trephined the bone, when a large coagulum was found lying upon the dura mater, and on removing this fluid, arterial blood freely welled up. The coma was relieved by the operation, and the patient made a good recovery. The most serious objection to the application of the trephine in cases of extravasation does not, however, consist so much in determining the existence of effused blood within the cranium, or that the extravasation is of

the meningeal form, but rather in diagnosing that it is so seated between the dura mater and the skull as to admit of removal; not being effused at the base, or so widely coagulated over the surface of the brain as to be unable to escape through the aperture that may be made. The likelihood of the co-existence of fracture of the base of the skull and of laceration of the brain, giving rise to the cerebral form of extravasation, must also be taken into account. For these various reasons, surgeons now very properly content themselves, in the great majority of cases of extravasation, with the employment of antiphlogistic treatment, on the principles already stated. With this view, the head should be shaved, the ice-bladder applied, the patient bled, purged, and kept at perfect rest. If, however, the signs are urgent, and pretty clearly indicate the meningeal form of extravasation, and more especially if there be hemiplegia on the side opposed to that on which the blow has been received, with an injury in the course of the middle meningeal artery, the trephine may be applied at the seat of injury and the blood removed. It must be borne in mind that, however clear the signs, the extravasation may not be met with where the surgeon expects to find it. Under these circumstances it is better not to prosecute the search by making fresh trephine apertures. In no case would a prudent surgeon trephine over the course of the middle meningeal artery, in the absence of local symptoms, on the chance of finding the blood there, as has been recommended by some of the older surgeons.

Operation of Trephining. — Before concluding the subject of injuries of the head, it is necessary to say a few words on the operation of trephining, which, though far less commonly employed in the present day than heretofore, is one of sufficient frequency in practice, as well as of great importance from the serious nature of the cases that usually require it.

The trephine may be applied to the cranium for two purposes; either with the view of preventing inflammation and its consequences, or for the purpose of removing some cause of compression. The only case in which *preventive* trephining is practised by modern surgeons is that for the punctured or starred fracture of the skull, without stupor; in all other instances in which it is called for, the object of its application is the removal of a cause of compression or of irritation of the brain, such as a depressed portion of bone, foreign bodies either fixed in the skull, or lying close under it, and pus or blood extravasated within the cranium.

The operation of trephining is by no means a favorable one in its results. Of 45 cases reported by Dr. Lenter, as occurring at the New York Hospital, in which, however, there is no distinction made between the application of the trephine proper and of various instruments, such as the elevator, Hey's saw, &c., belonging to a trephining case, only 11, or about one-fourth, recovered. Of 13 cases in which the trephine proper was used at University College Hospital, by Mr. Cooper, Mr. Liston, and myself, 4 patients recovered; 1 other died of injury of the spine unconnected with the operation, and the remaining 8 died of inflammation of the brain or its membranes.

The Parisian surgeons have not been very successful. Nélaton says, that all the cases of injury of the head, in which the trephine has been used in the Parisian hospitals during the last fifteen years, and they are 16 in number, have terminated fatally.

The trephine should have a well-tempered crown, serrated half-way up its exterior, the teeth should be short and broad, and not too fine; the centre pin must not project more than about the eighth of an inch, and care must be taken that the screw which fixes it is in good working order. The other instruments required are a Hey's saw, an elevator that will not readily snap, and a pair of strong dissecting forceps.

The operation itself should be conducted in the following way: — The head having been shaved, and the portion of the skull to which the trephine is to be

applied having been freely exposed by means of a crucial or T-shaped incision, or by the enlargement of any wound that may exist, the trephine with the centre pin protruded and well screwed down, is to be firmly applied until its teeth touch the skull; it is then worked with rather a sharp, light, and quick movement, the pressure being exercised as the hand is carried from left to right. The centre pin must be withdrawn so soon as a good groove is formed by the crown, lest it perforate the skull first and injure the dura mater. In this way the outer table of the skull is quickly divided, and the diploe cut into; the detritus which now rises by the crown of the trephine is soft and bloody, instead of being dry, as it is whilst the outer table is being sawn. As the instrument approaches the dura mater, the sawing must be conducted more warily, and must every now and then be interrupted, in order that the surgeon may examine with the flat end of a probe, or with a quill, the depth that has been obtained, care being taken that this is uniform throughout the circle. The surgeon now makes each turn very lightly, and now and then tries with a slight to-and-fro movement whether the circle of bone is loose. So soon as it is, he withdraws it in the crown of the trephine, or raises it out by means of the elevator. In this operation the dura mater must not be wounded; if it be injured fatal consequences will probably ensue. The objects for which the trephining has been had recourse to must now be carried out, depressed bone elevated or removed, and pus or blood evacuated. The scalp should then be laid down again, a few sutures and a piece of water-dressing being applied.

There are certain parts of the skull, over the venous sinuses, for instance, and near the base, to which no prudent surgeon would apply the instrument. So also, if it were ever thought necessary to trephine at the frontal sinuses, the outer table must first be removed with a large crown, and the inner table sawn out with a smaller one.

After the operation careful attention must be paid to antiphlogistic measures of a preventive and curative kind, the great danger to be apprehended being inflammation of the brain and its membranes. In some cases also there is reason to believe that suppurative phlebitis of the sinuses and veins of the diploe have been the cause of death.

CHAPTER XIX.

INJURIES OF THE SPINE.

Injuries of the spine, like those of the head, derive their importance from the degree to which the enclosed nervous centre is implicated.

The spinal cord is subject to concussion, compression, and inflammation, as the result of external violence, and any of those conditions may occur without injury to the osseous and ligamentous structures investing it, although, in the majority of cases, they are directly occasioned by fracture or dislocation of the vertebræ. It may also be partially or completely divided by cutting-instruments, gun-shot wounds, or a broken vertebra.

Concussion of the spine varies greatly in severity. In many cases of falls from a height, and of blows upon the back, the patient complains of great pain at some part of the spine, inability to stand, and a certain degree of weakness of the lower extremities. In these cases, rest for a few days in bed, and more especially the application of dry cupping, or the abstraction of a few ounces of blood from over the seat of injury, will speedily remove the symptoms.

In other instances, however, the symptoms, slight at first, quickly become much increased in severity, or may, from the commencement, assume a serious character. In such cases, there is some pain at the seat of injury, below which there is more or less complete paralysis, sometimes consisting in mere debility or impaired mobility of the lower limbs, at others of loss of sensibility and motion. The sphincters are always affected, there being more or less incontinence of flatus and fæces, and some difficulty in emptying the bladder, amounting at last to complete retention of urine. These symptoms may, after continuing for some weeks or months, gradually lessen in intensity until mere debility is left, which, however, is apt to continue for a considerable time. In other cases again, they continue permanently, or terminate in speedy death.

In the more chronic forms of the affection, *traumatic myelitis*, usually of a fatal character, is apt to come on. In these cases there is paralysis of the parts below the seat of injury, associated with pain and twitching of the muscles, the pain in the back being much increased on pressure.

After death in cases of concussion of the spinal cord, every condition is found between slight ecchymosis, with some redness of the membranes, through all the gradations of softening up to complete disorganization of its structure. In many cases there is extravasation of blood into the substance of the cord itself. When this occurs the clot is most commonly found in the grey substance, or if not actually confined to this, at all events, towards the centre of the cord and opposite the seat of injury. Occasionally blood is effused largely into the spinal canal, compressing the cord, and thus occasioning gradually increasing paraplegia. Sir A. Cooper mentions a case in which this happened as the result of a strain, the patient dying at about the end of a twelvemonth. When myelitis has occurred, the membranes are found congested and sloughy, and the cord itself in every degree of red softening up to complete liquefaction.

In the *treatment* of concussion of the spine it is necessary to keep the patient in the recumbent position until the lower limbs have regained their power. The most convenient attitude for this purpose is upon the prone couch, which will be described when we come to speak of diseases of the spine. The patient should be cupped over the seat of injury, have his water drawn off, his bowels opened by enemata, and his strength supported by a nourishing system of diet, which must be continued so long as the paralysis lasts. After a time, more especially if the bladder continues weak, blisters should be applied to the spine, and when merely a degree of debility is left in the lower limbs, the raw surface so produced may advantageously be sprinkled with strychnine properly diluted with starch.

Wounds of the spinal cord may occur from stabs with pointed instruments, from gun-shot violence, or more frequently from the injury inflicted upon it by the pressure of fractured vertebræ. In the latter form of injury there is an association of wound and compression, giving rise essentially to the same symptoms as if the cord were divided.

When the spinal cord is completely divided a certain set of symptoms occur that are common to all cases, at whatever part of the cord the injury has been inflicted, provided it be not so high up as to cause instant death.

In the first place there is complete paralysis of sense and motion in all parts below the seat of injury, though the mental manifestations continue intact. The precise seat of injury may often be diagnosed by the extent of the paralysis. Thus in injury of the lower part of the spine there may be paralysis of all those parts supplied by the nerves of the sacral plexus, whilst those from the lumbar are not affected, the sensibility being lost below the knees, whilst above it is perfect — thus leading to the inference that the injury has been inflicted above the one and below the other set of nerves. The temperature of the part becomes lowered; though in some cases when the paralysis is not quite complete, the reverse has been observed; and after a time, a visible diminution takes place in

its nutritive activity, the circulation becoming feeble, with a tendency to congestion at depending points. This lessening of nutritive vigor is not, however, confined to the paralyzed parts, but the whole of the system participates in it, the patient becoming speedily anemic and cachectic. The skin assumes a dirty cadaverous hue, and the cuticle usually exfoliates in branny flakes.

These general symptoms of paralysis as the result of injury present important modifications according to the point at which the cord is divided.

When the injury has been inflicted in *the lumbar or lower part of the dorsal region*, there will be found to be complete paralysis of all the parts supplied by the nerves given off from the sacral or lumbar plexuses, or both; hence there will be paralysis of the lower extremities, of the-genital organs, and of the trunk as high as the seat of injury. There is always in these cases relaxation of the sphincter ani, and hence incontinence of flatus, and, to a great extent, of fæces. There is at first retention of urine in consequence of the paralyzed state of the bladder, the body of which is unable to expel its contents; after a time, however, the urine dribbles away as fast as it is poured into the over-distended organ, the neck of which has lost its contractile sphincter-like action. After the first few days the urine will be observed to be ammoniacal in odor, and alkaline in reaction. This is probably owing to changes that it undergoes after it has passed into the bladder, the mucous membrane of which becomes chronically inflamed, secreting a viscid alkaline muco-pus, which mixes with the urine. In the early stages of the accident the penis will usually be observed to be in a state of semi-erection. Patients who have met with injuries of this portion of the spinal cord may live for many months and even for a year or two, but eventually die, usually with sloughing of the nates, or from the supervention of some intercurrent visceral inflammation of a low type.

When the cord is divided in *the upper dorsal region*, about the level of the third dorsal vertebra, we have not only the train of symptoms that has just been mentioned as characteristic of this injury lower down, but another set of symptoms is superadded to them, owing to the respiration being interfered with in consequence of the paralysis of the greater portion of the expiratory muscles. The intercostals, and those constituting the abdominal wall, no longer acting, an imperfect expiration is solely effected by the elasticity of the walls of the chest, and those expiratory movements, such as sneezing and coughing, which are of a muscular character, cannot be accomplished. In these cases it will be noticed, that during inspiration, which is effected almost exclusively by the diaphragm, the ribs are depressed instead of being expanded and raised, and the abdominal wall, which is soft and flaccid, is protruded far beyond its normal limits. In consequence of the impediment to respiration the blood is not properly arterialized, and a slow process of asphyxia goes on, usually running into congestive pneumonia, and terminating fatally in about a fortnight or three weeks.

When the injury is situated in *the lower cervical vertebræ*, not only do all the preceding symptoms occur, but there will be paralysis of the upper extremities as well, and the inspiration being entirely diaphragmatic, the circulation speedily becomes affected, the countenance assuming a suffused and purplish look. If the cord have been divided immediately above the brachial plexus, the whole of the upper extremities will be completely paralyzed; but if the injury be opposite the sixth cervical vertebra, it may happen that the upper extremities are only partially paralyzed. This happened in two cases of fracture of the spine in this region that have lately been under my care at the hospital. In both these instances the paralysis existed on the ulnar but not on the radial side of the arms, owing to the external cutaneous and radial nerves arising higher from the plexus than the ulnar, and thus just escaping injury. It is remarkable that in both these cases there was acute cutaneous sensibility in the arms along the whole line of junction between the paralyzed and the sound

parts. In cases of injury of the cord in this situation death usually occurs by asphyxia in the course of a week.

When the division of the spinal cord takes place *above the origin of the phrenic nerve*, opposite to or above the third cervical vertebra, instantaneous death results from the paralysis of the diaphragm, as well as of the rest of the respiratory muscles, inducing sudden asphyxia.

It occasionally happens in partial division of the cord, as in some cases of compression resulting from fracture, that the symptoms are not so clearly marked as in the instances that have just been recorded. Thus, for instance, the paralysis may not extend to all the parts below the seat of injury; it may be attended by severe pain in some of the semi-paralyzed parts; or, motion may be affected in one limb, and sensibility in another. These deviations from what is usual may generally be explained by some peculiarity in the seat of the injury to the cord, or by the extent of its division.

Fractures of the spine commonly result either from direct blows upon the back, or else by falls upon the head, in such a way that the body is violently bent forwards.

The *signs* of this injury, though by no means unequivocal in many cases, are yet sufficiently obvious in the majority of instances to admit of an easy diagnosis. They are of two kinds; those presented by the injury of the bone, and those dependent on injury by compression or laceration, or both, of the spinal cord.

The local signs are usually pain at the seat of injury, greatly increased on pressure or on moving the part, inequality of the line of the spinous processes, with depression of the upper portion of the spine, and corresponding prominence of the lower. There is an inability to support the body in the erect position, and to move the spine in any way; hence, when the upper portion of the column is injured, the patient holds his head in a stiff and constrained attitude, fearing to turn it to either side.

The more general symptoms of fracture of the spine are dependent upon the injury that the cord has received. If the fracture have not implicated the spinal canal, as when only the tip of a spinous process has been broken off, or if it be unattended by displacement, although it may traverse the body and arches, no symptoms depending upon injury of the cord need exist, and indeed occasionally are absent. But in these cases even there is usually some degree of paralysis, owing perhaps to the concussion to which the cord has been subjected at the moment of injury; and occasionally a sudden movement by the patient will bring on displacement, by which the cord is compressed and all the parts below the injured spot paralyzed. A woman was admitted into University College Hospital with an injury of the neck, the nature of which could not be accurately ascertained. She was in no way paralyzed, but kept her head in a fixed position. A few days after admission, whilst making a movement in bed, by which she turned her head, she fell back dead. On examination it was found that the spinous process of the fifth cervical vertebra had been broken off short, and was impacted in such a way between the arches of this and the fourth as to compress the cord. This impaction and consequent compression probably occurred at the time of the incautious movement, thus producing immediate death.

When there is only partial displacement of the fracture there may be but incomplete paralysis of the parts below the injury; of one arm, one leg, &c. In these cases there is usually great pain experienced at the seat of fracture, and extending from it along the line of junction between the paralyzed and sound parts round the body or along a limb. This symptom, which is of great importance as exactly defining the seat of injury, is owing, as I found in a case of fracture of the sixth cervical vertebra under my care, to the fractured bone compressing and irritating the nerve that issues from the vertebral notch opposite the seat of injury.

In the majority of cases of fracture of the spine there is, however, such displacement of the bone as to compress the whole thickness of cord, and thus to occasion complete paralysis. In these cases the symptoms are such as have been detailed when speaking of injuries of the spinal cord on the compression, laceration, or divisions of which they are dependent.

Fractures of the spine are inevitably fatal, death ensuing in the two different ways, and at the different periods that have already been mentioned.

The *treatment* of these injuries is sufficiently simple. No attempt at reduction can of course be made. All our efforts must be directed to the prolongation of life. With this view, if the fracture be in such a situation, at any point below the upper dorsal vertebra, for instance, as will hold out a prospect of the life being prolonged for a few weeks or months, means must be taken to prevent the occurrence of sloughing of the nates, an accident that is of common, and usually of fatal termination in these cases. The patient should therefore be laid at once on a water-bed, cushion, or mattress; he must be kept scrupulously clean, and his urine should be drawn off twice in the day at regular hours. If, as usually happens after a time, the bowels become confined, relief must be afforded by castor oil, or turpentine enemata. A nourishing diet must be administered, and perfect rest in one position enjoined. In this way life may be maintained for a considerable length of time; and it is probable that ossific union of the fracture may sometimes take place, though the patient may not recover from the paralysis, and will die eventually from disease of the cord.

In cases of fracture of the spine with depression of the arches, it has been proposed to trephine the injured bone and elevate the fragment that has been driven in upon the cord. This operation, though performed by Cline, Cooper, and Bell, is, I believe, now generally abandoned by the best surgeons in this country, owing to its invariable, and, indeed, intrinsically fatal character.

Dislocations of the spine. — On looking at the arrangement of the articular surfaces of the vertebræ, the very limited motion of which they are susceptible, and the way in which they are closely knit together by strong ligaments and short and powerful muscles, it is obvious that dislocations of these bones must be excessively rare. So seldom indeed do they occur that their existence has been denied by many surgeons. But yet there are a sufficient number of instances on record to prove incontestably that these accidents may happen. Those cases that have been met with have usually been associated with partial fracture, but this complication is not necessary. In all, the displacement was incomplete, and indeed a complete dislocation cannot occur.

The dislocation of the *atlas* from the occipital bone has only been described in two instances; — by Lassus and by Paletta. In the case by Lassus, death ensued in six hours, and the right vertebral artery was found to be ruptured. In the other case, the patient is said to have lived for five days, but the report is so incomplete that little value can be attached to it.

Dislocations of the *axis* from the atlas are of more frequent occurrence. They may happen with or without fracture of the odontoid process. In either case the axis is carried backwards, and the spinal cord thus compressed. This accident is said to have taken place by persons in play lifting a child off the ground by its head; the combination of rotation and traction in this movement being especially dangerous, and liable to occasion the accident. For the same reasons it has been met with in persons executed by hanging. Death would probably be instantaneous under these circumstances. It has, however, been stated that in dislocations of this kind, life has been saved by the surgeon placing his knees against the patient's shoulders, and drawing or twisting the head into position. This, however, I cannot believe possible, if the displacement have been complete, as death must be instantaneous; the cases of supposed dislocation and reduction having probably been instances of concussion of the cord with sprain of the neck.

Dislocation of any one of *the five lower cervical vertebræ* may occur. These injuries are usually associated with fracture, but sometimes, though rarely, they happen without this complication. In these dislocations, as in those that have already been described, the displaced bone carries with it the whole of that portion of the vertebral column which is above it, no single bone being dislocated both from those above and those below it.

These accidents most commonly happen by forcible flexion of the neck forwards, though traction and rotation conjoined have occasioned them. In a case of luxation of the sixth from the seventh cervical vertebra, recorded by J. Roux, the accident happened by a sailor plunging into the sea for the purpose of bathing, coming head foremost against a sail which had been spread out to prevent the attack of sharks; he died on the fourth day. In a patient of mine who fell out of the window in such a way that the head was doubled forwards upon the chest, and who was brought to the hospital with supposed fracture of the spine, we found after death, which occurred on the fifth day, that the seventh cervical vertebra had been dislocated forwards from the first dorsal, there being a wide gap posteriorly between the lamina of these bones, with horizontal splitting of the intervertebral substance, detaching with it an extremely thin and small layer of bone from the body of the seventh. There was no fracture about the articular processes, which were completely separated from one another. The symptoms of this accident are necessarily excessively obscure, being very liable to be confounded with those of fracture. Reduction has been effected in a sufficient number of cases of this kind to justify the proceeding being adopted when the danger is imminent.

Dislocation of *the transverse processes* of the cervical vertebræ occasionally occurs. In these cases the patient, after a sudden movement, or a fall on the head, feels much pain and stiffness in the neck, the head being fixed immovably, and turned to the opposite side to that on which the displacement has occurred. In these cases I have known reduction effected by the surgeon placing his knees against the patient's shoulders, drawing on the head, and then turning it into position, the return being effected with a distinct snap.

INJURIES OF THE FACE.

Cuts about the *cheeks and forehead* are of common occurrence. These injuries present nothing peculiar, except that the structures of the face partake of the same tendency to ready repair, as well as to the supervention of erysipeloid inflammation, that characterize the scalp when injured. In the treatment of these wounds it is of much consequence to leave as little scarring as possible. Hence the edges, after being well cleaned, should be brought neatly into apposition by fine hare-lip pins and the twisted suture, or by a few points of interrupted suture; more particularly if they are in a transverse direction, and implicate the lips or nose. When in the neighborhood of the eyelids, especial care must be taken to prevent any loss of substance, lest the contraction of the cicatrix produce eversion of the lid. In those cases in which a portion of the nose or lip has been lost, much may be done to repair the deformity by properly-conducted plastic operations, as will be described when we come to treat of diseases of these structures. The bleeding, which is often rather free in wounds of the face, in consequence of some arterial branch having been divided, may often be arrested by passing the hare-lip pin under the vessel, and applying the twisted suture above it, so that it may be compressed. If the lip is cut from within, by being struck against the teeth, the coronary artery may be divided, the patient swallowing the blood that flows into the mouth. Some years ago, a man was brought to the hospital, drunk, and much bruised about the face. Shortly after his admission he vomited up a large quantity of blood, which was at first supposed to proceed from some internal injury, but on examining his mouth, it

was found that the blood came from the coronary artery of the lip, which was divided, together with the mucous membrane.

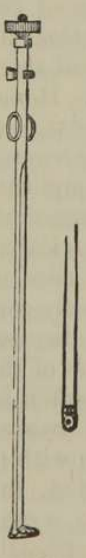
It occasionally happens as the result of wounds or abscesses of the cheek that *the parotid duct* is cut across, in consequence of which the wound does not close, a trickling of saliva taking place upon the outside of the cheek, so as to establish a *salivary fistula*, a source of much disfigurement and inconvenience to the patient; the surface surrounding it being puckered in a somewhat excoriated, and the fistula opening by a granulating aperture.

If this condition is recent, a cure may sometimes be accomplished, by paring the edges of the external wound, bringing them into close apposition, and applying pressure upon the part. If it be of old standing, the probability is that the aperture into the mouth is closed, and that something more will be required than bringing the lips of the wound together. To get it to close, we may adopt the plan recommended by Desault, of passing a small seton from the mouth into the fistula, so as to make an artificial opening into the mouth, and then, when the course of the saliva has thus been established, closing the external wound. In order to make the internal artificial opening permanently fistulous, some surgeons have advantageously employed a red-hot wire.

Besides the fistula of the Stenonian duct, other fistulous apertures may take place in the cheek, as the result of injury or disease, allowing the escape of a small quantity of saliva. These openings are always difficult to heal: the edges becoming callous, and not readily taking on reparative action. Closure may be effected in some cases by cauterization with the nitrate of silver, or with a red-hot wire, due attention being paid to the general health. In other cases, again, the electric cautery, as employed by my colleague, Mr. Marshall, may prove successful. If, however, the opening be free, with much indurated structure about it, the surgeon may find it necessary to excise a portion of the edges before bringing them together.

Foreign bodies in the nostrils, such as pebbles, beads, dried peas, &c., are occasionally met with in children, having been stuffed up in play, and becoming so firmly fixed as to require extraction by the surgeon. For this purpose a pair of urethral or polypus forceps will usually be found convenient. In some cases, however, a bent probe or an ear-scoop will remove the impacted body most easily.

Fig. 131.



The Ears are not unfrequently wounded in injuries of the head and scalp; a portion of the external ear being sometimes torn down and hanging over the side of the face. In these cases, as in scalp injuries, the part should never be removed, but, however lacerated and contused, should be cleaned and replaced by means of a few points of suture and strips of plaster. When the cartilaginous portion of the ear is divided, nice management is usually required in effecting perfect union.

Foreign bodies are often pushed into the ears of children in play with one another. When pointed or angular, such as pieces of stick, they may readily be extracted with forceps; but when round and small, such as pebbles or beads, they are not so easily removed. Here the use of this instrument is of little service, the bent ear-scoop may occasionally be got round the body and thus remove it.

In some cases I have found an instrument, as here represented, fig. 131, and made by Coxeter on the model of Civale's urethral scoop, useful in getting a foreign body out of the ear. It can be introduced straight and then passed beyond it, when, by the action of a screw in the handle, the scoop is curved forwards, and so enables extraction to be readily effected. In other cases it is best got out by forcibly syringing the ear with tepid water, injected by means of a large brass syringe in a full stream, the pinna being drawn up so as to straighten the external

meatus. In this way the bead or pebble is soon washed out by the reflux of the water striking against the tympanum. Should these means not suffice it is better to leave matters alone, and to allow the foreign body to become loosened, than to poke instruments into the ear with the view of forcibly extracting it. These attempts are ill-advised, and I have known death follow prolonged and unsuccessful efforts at the extraction of a pebble from the ear.

INJURIES OF THE ORBIT if deep are always serious, on account of the proximity of the brain; thus it may happen that a pointed body, such as a piece of stick or a knife thrust into the orbit, perforates its superior wall, thus producing a fatal wound of the brain. Occasionally inflammation is set up in the loose cellulo-adipose tissue contained in this cavity, giving rise to abscess, which may point in either eyelid; or, to inflammation extending itself to the encephalon. In other cases wounds of the orbit may be followed by loss of vision, without the eyeball being touched, either in consequence of injury of the optic nerve, or perhaps from the division of some of the other nerves of the orbit producing sympathetic amaurosis, as occasionally happens even from ordinary wounds of the face, implicating some of the terminal branches of the fifth pair.

INJURIES OF THE EYE-BALL are so commonly followed by impairment or total loss of vision as to constitute a most important series of accidents; the delicacy of the structure of this organ being such, that slight wound of its more transparent parts, or displacement of the lens, is often followed by complete opacity and loss of sight.

Injuries of this organ may be divided into contusions and wounds.

A *contusion* of the eyeball, without rupture or apparent injury of any of its structures, may give rise to such concussion of the retina as to be followed by temporary or permanent amaurosis. More frequently contusions of the eye are accompanied by extravasation of blood under the conjunctiva, and much ecchymosis of the eyelids. A "black-eye" is best treated by the continuous application of a weak arnica and spirit lotion.

Contusion of the eye with rupture of some of the structures of the ball is a most serious accident. The cornea may be ruptured, the humors lost, and vision permanently destroyed. Most frequently the rupture is internal, the outer tunics escaping all injury. In this case we may have an extravasation of blood into the eye, completely filling the anterior chamber, hiding and complicating deeper mischief within the ball. This condition, termed *hæmophthalmia*, is frequently associated with separation of the ciliary margin of the iris. In other cases again, there may be displacement of the crystalline lens, which may be driven into the vitreous humor, be engaged in the pupillary aperture, or fall forwards into the anterior chamber. As a consequence of such injuries the eye usually becomes inflamed with intense frontal and circum-orbital pain: disorganization of the ball, and ultimately loss of vision ensuing.

The *treatment* of these injuries must always be of an active antiphlogistic character. Blood should be freely taken from the arm by venesection, and from the temple by cupping, the iris being dilated by the application to the eye of a solution of the sulphate of atropine, of the strength of two grains to the ounce of distilled water; the patient must be kept in a darkened room, on a strictly antiphlogistic regimen, and should be put under the influence of calomel and opium, as speedily as possible. In this way, the inflammation will be subdued, the effused blood absorbed, and perhaps vision restored. In some cases, however, opaque masses and bands of lymph will be deposited in the anterior chamber and the pupillary aperture, preventing more or less completely the entry of light. If the lens be displaced into the posterior chamber it must be left there; if in the anterior it may be extracted through the cornea.

Wounds of the eyeball may be divided into those that are merely superficial, and do not penetrate into its chambers; and those that perforate its coats.

The *non-penetrating wounds* are usually inflicted by splinters of iron, or other

metallic bodies, which become fixed in the cornea, or between one of the eyelids and the ball. Very painful and troublesome injuries are sometimes inflicted by scratches of the eyeball with the nails of children. In the treatment of these superficial injuries, the first point is necessarily to remove any foreign body that is lodged. If it be fixed on the cornea, as commonly happens, it may be picked off with the point of a lancet or cataract needle; if it is a splinter of iron that has been so lodged, it is well to bear in mind that a small brown stain will be left after the metallic spicula has been taken off; this, however, will disappear in the course of a few days. In order to remove foreign bodies lodged between the ball and the eyelids, these must be everted so that the angle between the palpebral and ocular conjunctiva may be properly examined. For this purpose the lower eyelid need only be drawn down, whilst the patient is directed to look up; but the eversion of the upper eyelid requires some skill. It is best effected by laying a probe horizontally across it, immediately above the tarsal cartilage; the surgeon then taking the eyelashes and ciliary margin lightly between his finger and thumb, draws down the eyelid at the same time that he everts it by pressing the probe firmly backwards and downwards against the eyeball; the patient should then look down in order that the whole of the upper part of the conjunctiva, where the foreign body will probably be found, may be carefully examined.

Penetrating wounds of the eyeball present great variety; they are commonly inflicted by bits of stick, steel pens, children's toys, and not unfrequently during the shooting season by the explosion of faulty percussion caps, or the lodgment of a stray shot in the eye. In all cases these accidents are highly dangerous to vision, and when the foreign body lodges, it is usually permanently lost.

The danger that ensues usually arises either from the eye being opened to such an extent that the humors escape, or else, that the iris becoming engaged in a wound in the cornea, a hernial prolapse of it occurs. The remoter consequences usually arise from inflammation taking place within the globe, so as to produce an opaque cicatrix of the cornea or of the capsule of the lens; or else there is danger that adhesions may form, stretching across between the iris and the lens, or between these parts and the posterior surface of the cornea; or that inflammation may take place in all the structure of the ball, giving rise to disorganization of it.

The *treatment* of these penetrating wounds is strictly antiphlogistic. Bleeding in the arm, cupping on the temples, low diet, a darkened room, and the administration of calomel and opium, are the principal points to be attended to. If the iris have protruded through a wound in the cornea, it should be carefully pushed back, and a drop or two of the solution of atropine put upon the eye. If it cannot be returned, it may be removed with a pair of fine curved scissors, and at a later period any staphylomatous tumor that may form, should be touched repeatedly with a pointed piece of nitrate of silver. If there is a tendency to the formation of adhesions, or to the deposit of lymph within the pupil or the anterior chamber, our principal reliance should be upon small doses of calomel, in conjunction with opium. If the lens or its capsule have become opaque traumatic cataract thus forming, extraction may be required at a later period of the case.

WOUNDS OF THE MOUTH are seldom met with, except as the result of gun-shot violence. In these cases the amount of injury done to the soft structures, however great, is usually only secondary to the mischief that results to the brain, spinal cord, jaws and skull, and must of course be treated on the ordinary principles of gun-shot and lacerated wounds.

WOUNDS OF THE TONGUE usually occur from its tip or sides being caught between the teeth during an epileptic fit. They have been known to be inflicted purposely by insane patients, in attempts to excise this organ. Should the hemorrhage be free, the application of a ligature, or even of the actual cautery, may be needed to arrest it. These wounds generally assume a sloughy appear-

ance for a few days; then clean up, and granulate healthily. It is useless to bring the edges together by sutures, which readily cut out. If a large portion of the tip be nearly detached, it must, however, be supported in this way; but the threads should be thick, and passed deeply.

THE PALATE and the PHARYNX are sometimes lacerated by gun-shot injuries of the mouth; or the wound may result by something that the patient happened to have between his lips being driven forcibly backwards into his mouth. Thus, a tobacco-pipe may, by a blow on the face, be driven deeply into the substance of the tongue, or perhaps into the pharynx, wounding and lodging behind the arches of the palate, breaking off short; the fragment that is left in giving rise to abscess, to ulceration of the vessels, and perhaps fatal secondary hemorrhage. In a case that was under my care a short time back, the soft palate was nearly completely detached from the palatal bones by a deep transverse wound, caused by the end of a spoon being forcibly driven into the mouth.

INJURIES OF THE THROAT.

The cartilages of the larynx may be displaced, dislocated as it were by violent blows; or they may be fractured, though but very rarely, the rupture in some cases taking place transversely, in others longitudinally. Digital examination of the part would at once detect the nature of the injury. In all these injuries there is danger of asphyxia, which indeed may be induced by simple concussion of the larynx. Should these symptoms be very urgent, tracheotomy might be required. If not, attention to position and support of the head will suffice.

Wounds of the throat are of great frequency and importance, implicating as they do some of the most important organs in the body. They may be divided into three categories: —

1st. Those that do not extend into the air or food passages.

2nd. Those that implicate the air-passages, with or without injury of the œsophagus.

3rd. Those that are accompanied by injury of the spinal cord.

All these injuries are most commonly suicidal, and may be inflicted with every variety of cutting instrument. Hence, though incised, they are often jagged, and partake somewhat of the character of lacerated wounds, with great gaping of the edges.

In wounds of the first category there is very commonly free and even fatal hemorrhage, and this sometimes though none of the larger arterial or venous trunks are divided; the blood flowing abundantly from the venous plexuses and from the thyroid body. If the larger arteries are touched, as the carotid and its primary branches, the hemorrhage may be so abundant as to give rise to almost instantaneous death. Another source of danger in these cases proceeds from the admission of air into the veins of the so-called "dangerous region" of the neck. For this a free wound is by no means necessary, as is instanced by a remarkable case that occurred a few years ago near London, in which the introduction of a seton into the fore part of the neck was followed by death, from this cause.

The large nerves, such as the vagus and phrenic, cannot, in a suicidal wound, be divided without injury to the neighboring vessels. The division, however, of the respiratory nerves on one side only, or even of one of them, would in all probability be fatal in man, by interfering with the proper performance of the respiratory act. In a case with which I am acquainted, in which the phrenic nerve was divided during the operation of placing a ligature on the subclavian artery, death resulted in a few days from inflammatory congestion of the lungs.

In the treatment of wounds of the neck of this category, the principal points to be attended to are, in the first place, the arrest of hemorrhage by the ligature of all bleeding vessels, whether arterial or venous; and, secondly, bringing together

the lips of the wound. If the cut be longitudinal, this may be done by strips of plaster. If transverse, by a few points of suture and by position, the head being fixed, with the chin almost touching the sternum, and retained in this posture by tapes passing from the nightcap to a piece of bandage fixed round the chest. I have had under my care one case, in which, owing to the projection and mobility of the larynx, the wound did not unite, a large and deep gap being left, which required a series of plastic operations in order to effect its closure.

The *air-passages* are commonly wounded in suicidal attempts. They may be known to be opened by the air being heard and seen to bubble in and out of the wound during respiration. These wounds vary much in extent, from a small puncture with the point of a penknife to a cut extending completely across the throat, and even notching the vertebræ. They are frequently complicated with injuries of the larger vessels and nerves, and sometimes with wound of the œsophagus. Most commonly the cut is made high up in the neck, for the suicide thinking that it is the opening into the air-passages that destroys life, draws the razor across that part of the throat where these are most prominent and easily reached; and thus, by not wounding the larger vessels, which are saved by the projection of the larynx, frequently fails in accomplishing his object.

There are four situations in which these wounds occur: 1st. *Above the hyoid bone;* the cut extending into the mouth and wounding the root of the tongue. When the wound is in this situation it is usually attended with a good deal of hemorrhage; and there is much trouble in feeding the patient, as the power of swallowing is completely lost.

2d. The wound may be inflicted in *the thyro-hyoid space*, laying the pharynx open, but being altogether above the larynx. This is the most common situation for suicidal attempts. In many cases the incision is carried so low as to shave off or partly to detach the epiglottis and the folds of mucous membrane around it. In other cases again, the edges of the glottis or the arytenoid cartilages are injured, the cut extending back to the bodies of the vertebræ. In these cases also, there is great difficulty in swallowing, and great risk of the sudden supervention of œdema glottidis, and consequent suffocation.

3d. When *the larynx* is wounded the incision is usually transverse; but I have seen a longitudinal cut made through the larynx, so as to split the thyroid and cricoid cartilages perpendicularly. In these cases of wounded larynx there is much danger of the blood from the superficial parts trickling into the air-passages and asphyxiating the patient, and of inflammation of the bronchi and lungs supervening at a later period.

4th. Wounds of *the trachea* are not so common as those of the larynx, from which they differ but little in the attendant dangers. The œsophagus is seldom wounded, as it can only be reached through the trachea by a deep cut, which will probably implicate the large vessels on one side or the other. The spinal cord can only be injured by gun-shot wounds of the neck, which are necessarily fatal.

There are various sources of danger in wounds of the neck implicating the air-passages. The hemorrhage, whether it proceed from any of the larger trunks, or consist of general oozing from a vascular surface, may either prove directly fatal by the loss of blood, or indirectly so in consequence of the blood trickling into the air tube, and by accumulating in its smaller divisions producing suffocation. Another source of danger in some of these cases arises from the supervention of asphyxia, either in the way that has already been mentioned, or, in those cases in which the wound has been inflicted above the larynx, from the occurrence of œdema of the glottis. This condition may likewise occur in those cases in which the external opening is very small, and occasionally happens suddenly when the wound has nearly closed.

Another source of danger is the loss of the natural sensibility of the glottis, in consequence of which it no longer contracts on the application of a stimulus. Hence food taken in by the mouth may pass into the larynx and make its

appearance in the external wound, even though neither the pharynx nor the œsophagus have been wounded. This I have observed in many cases of cut-throat; hence the presence of food in the wound cannot in all cases be considered an evidence of injury to the food-passages. This occurrence is always a bad sign, and is never met with in the earlier periods of the injury; never, indeed, until a semi-asphyxial condition has come on, by which the nervous sensibilities are blunted, or until inflammation has been set up about the rima glottidis, giving rise to so much swelling as to interfere with the natural actions, and to deaden the perception of the part to the contact of a foreign body. In these cases also it will be found that the sensibility of the air-passages generally is much lowered, so that mucus accumulates in the bronchi often to a dangerous extent, the patient not feeling the necessity for expectoration, and often, indeed, having much difficulty in emptying his chest.

The occurrence of bronchitis and pneumonia, either from the inflammation extending downwards from the wound, or in consequence of the cold air entering the lungs directly, without being warmed by passing through the nasal cavities, is perhaps the most serious complication that can happen in these injuries, and constitutes a frequent source of death in those patients who survive the immediate effects of the wound.

The depressed mental condition of the patient also is usually unfavorable to recovery in all those instances in which the wound is suicidal, disposing him to the occurrence of low forms of inflammatory mischief.

Treatment.—We have already considered the management of these wounds of the throat that do not interest the mucous canals in this region. When these are opened the same general principles are required as in the former case. Hemorrhage must be arrested by the ligature of all the bleeding vessels, whether arteries or veins, so that no oozing or trickling into the wound may take place.

In some cases the hemorrhage consists principally of general venous oozing which cannot be stopped by ligature, the patient drawing a large quantity of blood into the air-passages through the wound in them. Under these circumstances, I have found it useful to introduce a large silver tube into the aperture in the windpipe, and to plug the wound around it. So soon as the bleeding has fairly ceased, the plugs and the tube must be removed.

The edges must next be brought together by a few stitches introduced at the sides, and by attention to position, the head being fixed by tapes as already described in the former section. I think with Liston that in these cases the wound should never be closely sewed up, or stitches introduced into the centre of the cut. If the edges of the integument be closely drawn together, coagula may accumulate behind them, in the deeper parts of the wound, so as to occasion a risk of suffocation, and as this must eventually close by granulation, no material advantage can possibly be gained by this practice.

There is an exception, however, to this rule of not using stitches in the central part of the wound in cut-throats; viz., in those cases in which the trachea has been completely cut across. Here a stitch or two on either side of the tube is necessary, in order to prevent the wide separation of the two portions that would otherwise take place, owing to the great mobility of the larynx and upper end of the windpipe.

In order to lessen the liability to inflammation of the lungs, the patient should be put into a room, the temperature of which is raised to about 80° Fah., with a piece of lightly folded muslin acting as a respirator laid over the wound. So soon as the cut surfaces begin to granulate, water-dressing may be applied, and the edge of the wound brought into apposition by strips of plaster, and a compress if necessary. During the treatment the principal danger proceeds from inflammatory affections of the chest; these must accordingly be counteracted by the temperature in which the patient is placed, and by as active

antiphlogistic remedies as his condition will admit of. It must, however, be remembered that the mental depression and the bodily exhaustion from loss of blood, that are commonly met with in these cases, do not allow a very active course of treatment to be pursued.

The administration of food in these cases is always a matter requiring much attention. As a general rule, the patient should be kept on a nourishing diet, with a moderate allowance of stimulants. If, as not uncommonly happens, the food passages are opened, in consequence of the wound extending into the mouth, the pharynx, or the œsophagus, it is of course impossible for the patient to swallow, and the administration of nourishment becomes a source of considerable difficulty. This is best accomplished by means of an elastic gum catheter passed through the mouth into the gullet or stomach. This is easier than passing the instrument through the nose, and much better than introducing it through the wound. In this way a pint or more of the strongest beef tea, ox-tail soup, or Liebig's "Liquor Carnis," which I have used on one or two occasions with advantage, mixed with two or three eggs, and having an ounce or two of brandy added to it, should be injected regularly night and morning, until the patient is able to swallow. In those cases in which the wound is above the larynx, there is occasional danger of the supervention of œdema of the glottis; should this occur, tracheotomy may become necessary in order to prolong the patient's life.

As after-consequences of wounds of the throat, we occasionally find stricture of the trachea or aerial fistula occurring. If the cordæ vocales happen to have been injured, loss of voice may result.

Aerial fistula may sometimes form, owing to skin being adherent to the edges of the wound or air tube, and chiefly occurs when the cut is in the thyro-hyoid space; adhesion taking place between the integuments, which are doubled in as is seen in the os hyoides above, and the surface of the thyroid cartilage below. When this takes place, there is a tendency to the fistula continuing patent. Under these circumstances I have found the following operation successful in closing it:

The edges of the fistulous opening being freely pared, and the knife passed under them for some distance, so as to detach them from subjacent parts, a vertical incision is made through the lower lip of opening — so as to split it downwards. Two points of suture are then inserted into each side of the horizontal incisions, bringing their edges in contact, *but the vertical cut is left free* for discharges and saliva to drain through. Unless this outlet be afforded, these fluids will burst through the sutures and cause them to cut out.

ASPHYXIA.

The surgical treatment of asphyxia includes the management of those cases in which respiration has been suspended by *drowning, suffocation, hanging, or the inhalation of irrespirable gases.* The general subject of suspended animation from these various causes cannot be discussed here, but we must briefly consider some points of practical importance in its treatment.

In cases of *drowning*, life is often recoverable, although the sufferer has been immersed in the water for a considerable time, for it must be borne in mind that though *immersed*, he may very probably not have been *submersed.* The period after which life ceases to be recoverable in cases of submersion, cannot be very accurately estimated. The officers of the Humane Society, who have great experience in these matters, state that most generally cases are not recoverable that have been more than four or five minutes under water. In these cases, however, although submersion may not continue for a longer period than this, the process of asphyxia does; this condition not ceasing on the withdrawal of the body from the water, but continuing until the blood in the

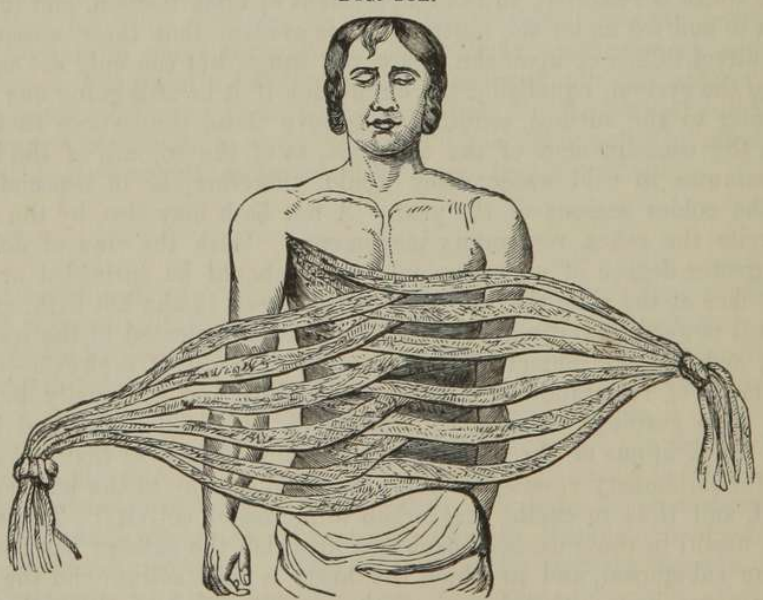
pulmonary vessels is aërated, either by the spontaneous or artificial inflation of the lungs. As several minutes are most commonly consumed in withdrawing the body from the water and conveying it to land, during which time no means can be taken to introduce air into the lungs, we must regard the asphyxia as continuing during the whole of this period; occupying, indeed, the time that intervenes between the last inspiration before complete submersion to the first inspiration, whether artificial or spontaneous, after the removal of the body from the water. The latest time at which life can be recalled, during this period, is the measure of the duration of life in asphyxia. If, however, during this period, the action of the heart should cease entirely, I agree with Sir B. Brodie, that the circulation can never be restored. But although we may put out of consideration those marvellous cases of restoration of life that are recorded by the older writers, and which are evidently unworthy of belief, are we to reject as exaggerated and apochryphal cases such as that by Mr. Smethurst, in which recovery took place after ten minutes' submersion; that by Dr. Douglas of Havre, in which the patient was not only submersed, but had actually sunk into, and was fixed in the mud at the bottom for from twelve to fourteen minutes; or that by Mr. Weeks, in which the submersion, on the testimony of the most credible witnesses, exceeded half an hour? I think that it would be unphilosophical in the extreme to deny the facts clearly stated by these gentlemen. The more so that in these, as in many other instances of apparent death from drowning, life appears to be prolonged by the patient falling into a state of syncope at the moment of immersion. We should therefore employ means of resuscitation, even though the body has been under water a considerable time.

The means recommended by the Humane Society for the recovery of persons from drowning, and employed at their Institution in Hyde Park, appear to be well adapted for the treatment of the less severe forms of asphyxia, or rather for cases of syncope from fright and immersions in cold water. They consist, after the nose and mouth have been cleared of any mucosities, in the application of heat by means of a bath at about the temperature of 100° Fahr. until the natural warmth is restored; in the employment of brisk friction, and in passing ammonia to and fro under the nostrils. It is evident that these measures can have no direct influence upon the heart and lungs, but can only act as general stimuli to the system, equalizing the circulation if it be still going on; and, by determining to the surface, tending to remove those congestions that are not so much the consequences of the asphyxia, as of the sojourn of the body for several minutes in cold water; they would, therefore, be of especial service during the colder seasons of the year. A hot bath may also, by the shock it gives, excite the reflex respiratory movements. With the view of doing this with a greater degree of certainty, cold water should be sprinkled or dashed upon the face at the time that the body is immersed in the hot bath, as in this way a most powerful exciting influence can be communicated to the respiratory muscles; and the first object of treatment in all cases of asphyxia — the re-establishment of respiration — would more rapidly and effectually be accomplished; deep gaspings ensuing, by which the air would be sucked into the remotest ramifications of the air-cells, arterializing the blood that had accumulated in the pulmonary vessels, enabling it to find its way to the left cavities of the heart, and thus to excite that organ to increased activity. These means, then, are useful in those cases of asphyxia in which the sufferer has been but a short time submersed, and in which the heart is still acting, and the respiratory movements have either begun of their own accord on the patient being removed from the water, or in which they are capable of being excited by the shock of a hot bath, aided by the dashing of cold water in the face. At the same time, the lungs may be filled with pure air, by compressing the chest and abdomen, so as to expel the vitiated air, and then allowing them to

recover their usual dimensions by the natural resiliency of their parietes. A small quantity of air will, in this way, be sucked in each time the chest is allowed to expand, and thus the re-establishment of the natural process of respiration may be much hastened. This simple mode of restoring the vital actions should never be omitted, as it is not attended with the least danger, and does not in any way interfere with the other measures employed. Dr. M. Hall has recommended that the patient be turned prone, so that the tongue may hang forwards, the larynx thus be opened, and that respiration be then set up by gentle pressure along the back, and by turning the patient on his side at regular intervals. If, by these means, we succeed in restoring the proper action of the respiratory movements, it will merely be necessary to pay attention to some points of the after-treatment that will presently be adverted to. Should we, however, fail in restoring respiration, we should have recourse to other and more active measures.

In the more severe cases of asphyxia, warmth should be applied by means of a hot-air bath, by which not only the natural temperature of the body may be re-established, but the blood in the capillaries of the surface be decarbonized. The most direct and efficient means, however, that we possess for the re-establishment of the circulation of these cases, is certainly *artificial respiration.* In this way the pulmonary artery and the capillaries of the lungs can alone be unloaded of the blood that has stagnated in them, and the left side and substance of the heart will be directly and rapidly supplied by red blood. The whole value of artificial respiration depends, however, upon the way in which it is employed. Inflation from the mouth of an assistant into the nostrils or mouth of the sufferer, though objectionable, as air once respired is not well fitted for the resuscitation of the few sparks of life that may be left in the cases in which it is desirable to employ this means, yet in many instances is the readiest and indeed the only mode by which respiration can be set up; and should therefore always be had recourse to in the first instance, or until other and more efficient means can be got ready.

Fig. 132.



The bellows, if properly constructed for artificial inflation, so that the quantity of air injected may be measured, are no doubt very useful; and if furnished with Leroy's trachea-pipes, or, what is better, with nostril-tubes, may be safely employed. About 15 cubic inches of air may be introduced at each

stroke of the bellows, and these should be worked ten or a dozen times in the minute. The lungs should be emptied by compression of the chest before beginning to inflate, and after each inflation by compressing the chest and abdomen; but care must also be taken not to employ much force, lest the air-cells be ruptured. But the safest, and at the same time the most efficient, mode of introducing pure air into the lungs, is either by means of the split sheet, as recommended by Leroy and Dalrymple (fig. 132), or else by alternately compressing the chest and abdomen with the hand, and then removing the pressure so as to allow the thorax to expand by the natural resiliency of its parietes, and thus, each time it expands, to allow a certain quantity of air to be sucked into the bronchi. The quantity introduced need not be large, for by the laws of the diffusion of gases, if fresh air be only introduced into the larger divisions of the bronchi, it will rapidly and with certainty find its way into the ultimate ramifications of these tubes. This last means of inflation has the additional advantage of resembling closely the natural process of respiration, which is one of expansion from without inwards, and not, as when the mouth or bellows are used, of pressure from within outwards. In one case the lungs are, as it were, drawn outwards, the air merely rushing in to fill up the vacuum that would otherwise be produced within the thorax by the expansion of its parietes; in the other they are forcibly pressed upon from within, and hence there is danger of rupture of the air-cells.

The inflation of the lungs with oxygen gas is likely to be of great service in extreme cases of asphyxia. I have found by experiment that the contractions of the heart can be excited by inflating the lungs with this gas, when the introduction of atmospheric air fails in doing so, and there are cases on record in which resuscitation was effected by inflating the lungs with oxygen gas, when in all probability it could not have been effected with any other means. In my Essay on Asphyxia will be found a case of resuscitation, in which oxygen was successfully employed by Mr. Weekes after the asphyxia had continued three quarters of an hour. Whatever means of resuscitation are adopted they should be continued for at least three or four hours, even though no signs of life show themselves; and after resuscitation the patient should be kept quiet in bed for some hours.

The danger of the supervention of *secondary asphyxia* after recovery has apparently taken place, is much increased, and indeed is usually brought about by some effort on the part of the patient that tends to embarrass the partially restored action of the heart and lungs. The patient being to all appearances resuscitated is allowed to get up and walk home, when the symptoms of asphyxia speedily return. Should symptoms of secondary asphyxia, such as stupor, laborious respiration, dilatation of the pupils, and convulsions, manifest themselves, artificial respiration should be immediately set up, and be maintained until the action of the heart has been fully restored. In these cases I should, from the very great efficacy of electricity, in the somewhat similar condition resulting from the administration of the narcotic poisons, be disposed to recommend slight shocks to be passed through the base of the brain and upper portion of the spinal cord, so as to stimulate the respiratory tracts.

Asphyxia from *the respiration of noxious gases*, such as carbonic acid, is best treated by exposing the surface of the body to cold air, by dashing cold water upon the face, and by setting up artificial respiration without delay, if the impression of cold upon the surface does not excite these actions. There is a peculiar variety of this kind of asphyxia, that is occasionally met with among infants, the true nature of which was pointed out to me by Mr. Wakley, who, as coroner, has had abundant opportunities of witnessing it, as it is not an uncommon cause of accidental death amongst the children of the poor. It is that condition in which a child is said to have been *overlaid;* the child sleeping with its mother or nurse being found in the morning suffocated in the

bed. On examination no marks of pressure will be found, but the right cavities of the heart and lungs are gorged with blood, and the surface livid, clearly indicating death by asphyxia. That this accident is not the result of the mother overlaying her child, is not only evident from the post mortem appearances, but was clearly proved by a melancholy case to which I was called a few years ago, in which a mother, on waking in the morning, found her twin infants lying dead on either side of her. Here it was evident from the position of the bodies that she could not have overlaid both. The true cause of death in these cases is the inhalation of, and slow suffocation by, the vitiated air which accumulates under the bed-clothes that have been drawn, for the sake of warmth, over the child's head. In such cases as these, resuscitation by artificial respiration should always be attempted if any signs of life be left.

In cases of *hanging*, death seldom results from pure asphyxia, but is usually the consequence, to a certain degree at least, of apoplexy, and commonly of simultaneous injury of the spinal cord. In these cases, bleeding from the jugular vein may be conjoined with artificial respiration.

If there should be a difficulty in setting up artificial respiration, through the mouth or nose, as is more especially likely to happen when the patient has been suffocated by breathing noxious gases, or in cases of hanging, tracheotomy or laryngotomy should at once be performed, and the lungs inflated through the opening thus made in the neck.

FOREIGN BODIES IN THE AIR-PASSAGES.

Though the introduction of foreign bodies into the air-passages is not a very common accident, yet a great variety of substances that admit of being swallowed has been found there: such as nut-shells, beans, cherry-stones, teeth, meat, money, buttons, pins, fish-bones, bullets, pills, pebbles, and pieces of stick. These foreign bodies are not introduced into the air-passages by any effort of deglutition, for no substance can be swallowed through the glottis; but if a person, whilst swallowing or holding any substance in his mouth makes a sudden inspiration, the current of air may draw it between the dilated lips of the glottis into the larynx.

The *symptoms* vary, according to the situation in which the foreign body is lodged, its nature and the period that has elapsed since the occurrence of the accident. The foreign body may lodge in one of the ventricles of the larynx, or, if light, it may float in the trachea, carried up and down by the movement of the air in expiration and inspiration. If too heavy for this, it will fall into one or other of the primary divisions of the trachea, and, as Aston Key has observed, will most commonly be found in the right bronchus, this being larger, and in a more direct line with the trachea than the left. If the substance be small, it may pass into one of the secondary divisions of the bronchi, and if it continue to be lodged here for a sufficient length of time, may make a kind of cavity for itself in the substance of the lung, where it may either lie in an abscess, or become encysted.

The symptoms may be divided into three stages. 1st. Those that immediately follow the introduction of the substance. 2d. Those produced by the irritation of its presence; and 3d. Symptoms of an inflammatory character coming on at a later period.

1st. The *immediate* symptoms vary somewhat, according to the size and nature of the body, and the part of the air-tube that it reaches. In all cases there is a feeling of intense suffocation, with great difficulty of breathing, and violent fits of spasmodic coughing, often attended by vomiting; during which the foreign body may be expelled. Indeed, its partial entry and immediate extrusion, by coughing, is not uncommon. In some cases immediate death may ensue at this period. If it have entered the air-passages fully, there is usually

violent coughing with feeling of suffocation for an hour or two, accompanied by lividity of the face, great anxiety, and sense of impending death. There is also usually pain felt about the episternal notch. These symptoms then gradually subside, but any movement on the part of the patient brings them on again with renewed violence. All these symptoms are most severe if the foreign body remains in the larynx; the voice being then croupy, irregular in tone, or lost. If it be lodged elsewhere, so often as it is coughed up, and strikes against the interior of the larynx, an intense feeling of suffocation is produced; and if it happen to become impacted there, sudden death may result, even though it be not of sufficient size to block up the air-passage, but apparently by the spasm that is induced. Some years ago a boy died at the Westminster Hospital before tracheotomy could be performed, in consequence of a flat piece of walnut-shell that had got into the trachea being suddenly coughed up, and becoming impacted in one of the ventricles of the larynx. The symptoms, during this period, are much less severe when the foreign body is in the trachea or bronchi.

2nd. When the foreign body has passed into the air-passages, and the immediate effects produced by its introduction have been got over, another set of symptoms, dependent on the irritation produced by it, is met with; and it is during the occurrence of these that the patient is most generally brought under the surgeon's observation. These symptoms are of two kinds; *general* and *auscultatory*.

The *general symptoms* consist of occasional fits of spasmodic cough, accompanied by much difficulty of breathing, a feeling of suffocation, and an appearance of urgent distress in the countenance. These attacks do not occur when the patient is tranquil, but come on whenever the foreign body is coughed up so as to strike the larynx, and the upper and more sensitive parts of the air-passages. As a general rule the distress is less, the lower the substance is lodged; the sensibility of the inferior portion of the trachea and bronchi being much less acute than that of the larynx and the upper part of the trachea. In consequence of the irritation, there is usually abundant expectoration of frothy mucus.

The *auscultatory signs* depend necessarily upon the situation of the foreign body. If this be loose and floating, it may be heard on applying the ear to the chest, moving up and down, and occasionally striking against the side of the trachea. If it be fixed, it will necessarily give rise to a certain degree of obstruction to the admission of the air beyond it, perhaps occasioning *bruits* during its passage. If it be impacted in the larynx, the voice will be hoarse and croupy, and there will be a loud rough sound in respiration, with much spasmodic cough and distress in breathing. If it be impacted in one bronchus, the respiratory murmur will be much diminished, or even absent, in the corresponding lung, and probably puerile in the other; whilst percussion will yield an equally clear and sonorous sound on both sides of the chest, air being contained in the lung of the obstructed side, but not readily passing in and out. If one of the subdivisions of either bronchus be occupied by the foreign body, the entrance of air will be prevented in the corresponding lobe of that lung, though it enter freely every other part of the chest. If the foreign body be angular, or perforated, peculiar sibilant and whistling noises may be heard as the air passes over and through it.

3rd. After a foreign body has been lodged for a day or two, symptoms of inflammation of the bronchi, or lungs, are apt to be set up; in some cases, however, these only occur after a considerable time has elapsed, or, perhaps, not at all, much depending, of course, on the shape and character of the irritant. If it continue to lodge, it generally forms for itself a cavity in the substance of the lung, whence purulent and bloody matters are continually expectorated, until the patient dies in the course of a few months, or a year or two, of phthisis. It has occasionally happened, however, that the substance has been coughed up

after a very long lodgment, the patient recovering. Thus, Tulpius relates a case in which a nut-shell was coughed up after being lodged for seven years, and Heckster one in which a ducat was thus brought up after a lapse of two years and a half, the patient, in both instances recovering. In other cases again death may ensue, although the foreign body is coughed up; thus, Sue relates an instance in which a pigeon-bone was spat up seventeen years after its introduction, the patient, however, dying in little more than a year from marasmus.

The *prognosis* depends more upon the nature of the foreign body and its size than on any other circumstances. If it be rough, angular, and hard, there is necessarily much more risk than if it be soluble in, or capable of disintegration by, the mucus of the air-passages. So long as the foreign body is allowed to remain in, the patient is in imminent danger, either from immediate and sudden suffocation, or from inflammation at a more remote period.

The danger depends greatly upon the length of time that it is allowed to lodge. Of 58 cases (4 of which have fallen under my own observation, the remaining 54 being collected from various sources, and constituting all those that I have been able to find recorded) I find the time that the foreign body was allowed to remain in, and the result of the case stated in 45 instances, which I have tabulated as follows:

PERIOD THAT IT REMAINED IN.	NUMBER OF CASES.	RECOVERED.	DIED.
Less than 24 hours	7	5	2
Between 24 and 48 hours	4	3	1
Between 48 hours and 1 week	12	5	7
Between 1 week and 1 month	8	4	4
Between 1 month and 3 months	3	3	0
Between 3 months and 1 year	4	2	2
More than 1 year	7	4	3
Total	45	26	19

From this it would appear that if the patient escaped the danger of the immediate introduction, the greatest risk occurred between the second day and the end of the first month, no less than 11 patients out of 20 dying during this period, and then that the mortality diminished until the third month, from which time it increased again.

The cause of death also varies according to the period at which the fatal result takes place. During the first twenty-four, and indeed, forty-eight hours, it happens from convulsions and sudden asphyxia. During the first few weeks it is apt to occur from inflammatory mischief within the chest, and after some months have elapsed the patient will be carried off by marasmus or phthisis.

Spontaneous expulsion of the foreign body, usually in a violent fit of coughing, occasionally occurs. Dr. Gross finds that there are 49 cases on record, in which the body was spontaneously expelled, the patient recovering. Of these, in 37 it was expelled during a fit of coughing. The period during which a foreign substance may remain in the air-passages before it is spontaneously expelled, varies from a few minutes to many months or years; in one case, a piece of bone introduced at the age of three, was not ejected until sixty years had elapsed. In 8 cases death followed the spontaneous expulsion.

Treatment. — This accident is always a very serious one, and hence requires prompt and energetic means to be used in order to save the patient; and fortunately the means at our disposal, consisting of the simple operation of opening the trachea, and thus facilitating the expulsion of the foreign body, are usually highly successful. I find that of 56 cases in which the result was noted, 33 lived,

and 23 died; but on analyzing these cases more closely, it appears that in 36 no operation was performed; the expulsion of the foreign body being trusted to the efforts of nature. Of these 20 died, and 16 lived. In the remaining 20 cases, tabulated below, tracheotomy was performed; of these 17 lived, and only 3 died, showing a remarkable success attendant on this operation.

PERIOD THAT IT REMAINED IN.	NUMBER OF CASES.	CURED.	DIED.
Less than 24 hours	3	2	1
Between 24 and 48 hours	2	2	0
Between 48 hours and 1 week	8	7	1
Between 1 week and 1 month	5	4	1
Between 1 and 3 months	2	2	0
Total	20	17	3

Dr. Gross has since extended these statistics very materially, and has found that out of 68 recorded cases in which tracheotomy has been performed, the operation was successful in 60, and in 8 the patient died.

Laryngo-tracheotomy was done in 13 cases; of these, 10 successes, and 3 deaths.

No means short of operation have been found of any use. Emetics, sternutations, inversion, and succussion of the body, are all either useless or dangerous, unless the air-passages have previously been opened.

If, therefore, a patient is seen a few hours, days, or weeks, after a foreign body has been introduced into the air-passages, or indeed at any period after the accident, tracheotomy ought to be performed. But it may be asked, for what purpose is the trachea opened? Why should not the foreign body be expelled through the same aperture by which it has entered? The opening in the trachea performs a double purpose; it not only serves as a ready and passive outlet for the expulsion of the foreign body, but also as a second breathing aperture in the event of its escaping through the glottis. The advantage of the opening in the trachea as a ready aperture of expulsion is evident, from the fact that of 14 of the operated cases in which it is stated how the foreign body was expelled, I find that in 12 it was ejected through the artificial opening, whilst in 2 only did it pass out through the glottis.

The reason why the foreign body usually passes out of the artificial opening in preference to escaping by the glottis, is, that the sides of one aperture are passive, whereas those of the other are highly sensitive and contractile. Before the operation is performed, it will be found that the great obstacle to expulsion is not only the sensitiveness of the larynx, great irritation being induced when it is touched from within, but also the contraction of the glottis, by the closure of which not only is the expulsion of the foreign body prevented, but respiration impeded. Every time the foreign body is coughed up so as to touch the interior of the larynx, intense dyspnœa will be produced, owing to sudden and involuntary closure of the glottis, by which respiration is entirely prevented and suffocation threatened; the expulsion of the body is consequently arrested, unless it were by chance to take the glottis by surprise, and pass through it at once in the same way that it has entered it, without touching its sides. If there is a second breathing aperture, though the larynx is equally irritated by the foreign body, yet this dyspnœa cannot occur, respiration being carried on uninterruptedly by one opening whilst the foreign body escapes through the other; and thus, under these circumstances, it may pass through the glottis with but little inconvenience to the patient.

In some cases the foreign body is expelled at once after the trachea has been

opened; in others, not until some hours, days, or even weeks, have elapsed Thus, in Houston's case, a piece of stick was not coughed up until ninety-seven days after the operation; and in Brodie's case, sixteen days elapsed before the half-sovereign came away.

In some cases laryngotomy has been performed instead of tracheotomy, and the foreign body has been equally well expelled. Dr. Gross gives 13 instances of this successful in their results, and 4 in which death followed the operation.

The expulsion has in some instances been facilitated by inverting the patient, shaking him, or striking him on the back. In cases in which the foreign body is not readily expelled, it has been proposed to introduce forceps and extract it. But although in some instances it has succeeded, the uncertainty and danger of such a proceeding is so great that few surgeons would be disposed to attempt it. The introduction of the forceps producing violent irritating cough, during which their points might readily be driven through the bronchi, and thus wound the lung or contiguous important structures. Besides this, there would be the danger of seizing the projecting angle at the bifurcation of the bronchi instead of the foreign body, and thus injuring the parts seriously. If the foreign body is fixed, the safer plan would certainly be to leave the aperture in the trachea unclosed, and wait for the loosening of the body, and its ultimate expulsion, which have hitherto occurred in all cases that have been operated on, or its escape might be facilitated by the gentle introduction of a probe, so as to dislodge it if seated in either bronchus, though this should be done with great caution, or the patient may be inverted and succussed when the expulsion may take place. Should it not then escape the wound should be kept open by means of blunt hooks, when, perhaps, it may be ejected.

Antiphlogistic treatment must be continued during the whole progress of the case. After the escape of the foreign body the opening in the trachea must be closed.

Dr. Gross' statistics are as follows: — of 159 cases *spontaneous expulsion* took place in 57; of these 49 recovered and 8 died.

Inversion of the body alone was successful in 5 cases.

Laryngotomy was practised in 17; of these 13 lived and 4 died.

Tracheotomy in 68; of these 60 lived and 8 died.

Laryngo-tracheotomy in 13; of these 10 lived and 3 died.

Scalds of the mouth, the pharynx, and the glottis, occasionally occur from attempts to swallow boiling water; or these parts are scorched by the inhalation of flame. The scalding of these parts chiefly happens to the children of the poor, who being in the habit of drinking cold water from the spout of a kettle, inadvertently attempt to take a draught from the same source when the water is boiling. The hot liquid is not swallowed, but though immediately ejected, has scalded the inside of the mouth and pharynx, giving rise to a considerable degree of inflammation, which, extending to the glottis, may produce œdema of it, and thus speedily destroy life by suffocation. In 3 cases which I have had an opportunity of examining after death, there was no sign of inflammation below the glottis, though the lips of this aperture were greatly swollen; and this I believe to be invariably the case, the inflammation not extending into the interior of the larynx, as has been pointed out by Dr. M. Hall.

The accident always reveals itself by very evident signs; the interior of the mouth looks white and scalded, the child complains of great pain, and difficulty of breathing soon sets in; which, unless efficiently relieved, may terminate in speedy suffocation.

In those cases in which these parts have been similarly injured by the flame produced by the explosion of gas or of fire-damp being sucked into the mouth, the same conditions present themselves.

In the *treatment* of this injury the main point to attend to is to subdue the inflammation, before it involves the glottis to a dangerous extent. With this

view, leeches should be freely applied to the neck, and calomel with antimony administered. If symptoms of urgent dyspnœa have set in, tracheotomy must be performed without delay, and if the child be not too young, a tube introduced into the aperture so made, and kept there until the swelling about the glottis has been subdued by a continuance of the antiphlogistic treatment. In the majority of the cases, however, that have fallen under my observation, in which this operation has been performed, the issue has been a fatal one, from the speedy supervention of broncho-pneumonia; but as it affords the only chance of life when the dyspnœa is urgent, it must be done, though its performance in very young children is often attended by much difficulty, from the shortness of the neck and the small size of the trachea.

INJURIES OF THE ŒSOPHAGUS.

Wounds of the œsophagus are chiefly met with in cases of cut throat, in which, as has been already stated in treating of these injuries, they occasion much difficulty by interfering with deglutition.

Foreign bodies not uncommonly become impacted in *the pharynx and œsophagus*, and may produce great inconvenience by their size or shape. If large, as a piece of money or a lump of meat, it may become fixed in the lower part of the pharynx or the commencement of the œsophagus, which is narrowed by the projection of the larynx backwards, and, compressing or occluding the orifice of the glottis, may asphyxiate the patient at once. If the foreign body get beyond this point, it usually becomes arrested near the termination of the œsophagus. When it is small, or pointed, like a fish-bone, pin, or bristle, it usually becomes entangled in the folds of mucous membrane that stretch from the root of the tongue to the epiglottis, or that lie along the sides of the pharynx. In some cases it may even perforate these, penetrating the substance of the larynx, and thus producing intense local irritation.

The *symptoms* occasioned by the impaction of a foreign body in the food-passages are sufficiently evident. The sensations of the patient, who usually complains of uneasiness about the top of the sternum; the difficulty that he has in swallowing solids, and perhaps the occurrence of an urgent sense of suffocation, lead to the detection of the accident. Should any doubt exist, the surgeon may, by introducing his finger, explore nearly the whole of the pharynx, and should examine the œsophagus by the cautious introduction of a well-oiled probang.

If the impaction is allowed to continue unrelieved, not only may deglutition and respiration be seriously interfered with, but ulceration of the œsophagus will take place, and abscess form either behind or between it and the trachea, or fatal hemorrhage may ensue.

It may happen that the foreign body, by transfixing the coats of the œsophagus, has seriously injured some neighboring parts of importance. Thus, in a curious case admitted into the University College Hospital, a juggler, in attempting to swallow a blunted sword, perforated the œsophagus and wounded the pericardium, death consequently resulting in the course of a few days.

The *treatment* must depend upon the nature of the foreign body and its situation. Should it be of large size, blocking up the pharynx so as to render respiration impracticable, it may be hooked out with the surgeon's fingers. Should asphyxia have been induced, it may be necessary to perform tracheotomy at once, and to keep up artificial respiration until the foreign body can be extracted. If it be small, or pointed, as a fish-bone or pin for instance, though it have lodged high up, the surgeon will usually experience great difficulty in its removal, as it gets entangled between and is covered in by the folds of the mucous membrane, where from its small size it may escape detection; and after it has been removed, the patient will experience for some time a pricking sen-

sation, as if it were still fixed. If the impacted body have got low down into the œsophagus, the surgeon must deal with it according to its nature. If smooth and soft, as a piece of meat for instance, it may be pushed down into the throat by the gentle pressure of the probang. If, however, it be rough, hard, or sharp pointed, as a piece of earthenware or bone, such a procedure would certainly cause perforation of the œsophagus, and serious mischief to the parts around; under these circumstances, therefore, an attempt at extraction should be made by means of long slightly curved forceps, constructed for the purpose.

It occasionally happens that the foreign body has become so firmly impacted in the pharynx or œsophagus that it cannot be extracted with any degree of force that it is prudent to use; under these circumstances it may become necessary to open the tube and thus remove it. The operation of *Pharyngotomy* or *Œsophagotomy* is, however, seldom called for, but if required may be performed by making an incision about four inches in length along the anterior border of the sterno-mastoid muscle on the left side of the neck, the œsophagus naturally curving somewhat towards this side. The dissection must then be carried with great caution between the carotid sheath and the larynx and trachea in a direction backwards, the omo-hyoid muscle having been divided in order to afford room. Care must be taken in prosecuting this deep dissection not to wound either of the thyroid arteries, more especially the inferior one, which will be endangered by carrying the incisions too low. When the pharynx or œsophagus has been reached, a sound or catheter should be passed through the mouth into this cavity, and pushed forwards so that its point may cause the walls to project, and thus serve as a guide to the surgeon. This must then be cut open, and the aperture thus made in the gullet enlarged by means of a probe-pointed bistoury, to a sufficient size, for the extraneous substance to be extracted.

CHAPTER XX.

INJURIES OF THE CHEST.

Wounds of the chest derive their principal interest and importance from the concomitant injury of the lungs, heart, or larger blood-vessels. When the parietes alone are wounded, the injury differs in nothing from similar lesions in other parts of the body. In these cases if the surgeon be in doubt whether the cavity of the chest has been penetrated or not, it is better for him to wait and to be guided in his opinion by the symptoms that manifest themselves, rather than by probing the wound, running the risk of converting it into what he dreads, a penetrating wound of the chest.

Wound of the lung is the most common and one of the most serious complications of injuries of the chest. It may occur without any external wound, from the ends of a broken rib being driven inwards upon this organ: most frequently, however, it happens from a penetrating wound of the chest, by stab or bullet.

The *symptoms* of this injury are sufficiently well marked. There is in the first place the immediate shock to the system that usually accompanies the infliction of a severe injury, the patient at the same time being seized with considerable difficulty of breathing, followed by much tickling and irritating cough, and the expectoration of frothy bloody mucus, or perhaps of large quantities of pure blood. If there be an external opening, the air may pass in and

out during the act of breathing, and emphysema, pneumo-thorax, or pneumonia will speedily supervene. On auscultating the chest immediately after the infliction of the injury, and before there is time for the supervention of any after-consequences, a loud rough crepitation will be distinctly audible at and around the seat of injury.

The principal dangers attending a wound of the lung arise from the bleeding, both external and internal, the occurrence of emphysema, pneumo-thorax, pneumonia, and empyema.

1st. The *hemorrhage* is usually abundant and often fatal, the patient spitting up a large quantity of florid, frothy blood. If it do not prove fatal in the early period of the injury, this bloody expectoration generally ceases in a great measure in the course of forty-eight hours, giving way to sputa of a more rusty character. If the external wound be very free, there may also be copious bleeding from it, but not unfrequently the blood finds its way into the pleural sac, rather than through the external aperture, and accumulating in it, may induce death, either by this internal and concealed hemorrhage, or by occasioning suffocation. The symptoms of this internal hemorrhage, *Hemothorax*, are those that generally characterize loss of blood, such as coldness and pallor of the surface, small weak pulse, and a tendency to collapse with increasing dyspnœa. The more special signs consist in an inability to lie on the uninjured side, with, in extreme cases, some bulging of the intercostal spaces, and an ecchymosed condition of the posterior part of the wounded side of the chest. The most important signs, however, are those that are furnished by auscultation. As the blood gravitates towards the back of the chest, between the posterior wall and the diaphragm, there will be gradually increasing dulness on percussion in this situation, with absence of respiratory murmur; the other portions of the lung, however, admitting air freely.

2d. *Emphysema*, or the infiltration of air into the cellular tissue of the body, and *pneumo-thorax*, or the accumulation of air in the cavity of the pleura, are not unfrequent complications of wounded lung, although not by any means invariably met with. These accidents more commonly occur when the external wound is small and oblique, than when it is large and direct, and not unfrequently happen in those cases in which the lung is punctured by a fractured rib, without there being any external wound. In the majority of cases, emphysema and pneumo-thorax occur together, but either may be met with separately. The mechanism of traumatic emphysema is most commonly as follows: The pleura costalis being wounded and the lung injured, at every inspiration a quantity of air is sucked into the pleural sac, either through the external wound, or, if none exist, from the hole in the lung, thus giving rise to pneumothorax. At every expiration, the air that thus accumulates in the pleural sac being compressed by the descent of the walls of the chest, is pumped into the cellular tissue around the edges of the wound; and if this be oblique and valvular, being unable to escape wholly through it, finds its way at each succeeding respiration further into the large cellular planes, first about the trunk and neck, and eventually, perhaps, into those of the body generally. Though this is the way in which emphysema usually occurs, it may be occasioned otherwise. Thus, for instance, I had lately under my care a woman who had extensive emphysema of the cellular tissue of the trunk from fractured ribs, but without any pneumo-thorax, the lung having been wounded at a spot where it was attached to the walls of the chest by old adhesions, and the air having passed through them into the cellular tissue of the body, without first entering the cavity of the pleura. Mr. Hilton has described a form of traumatic emphysema that arises by the rupture of an air-cell or bronchus without any external wound. The air, getting into the posterior mediastinum, and, finding its way along the nerves and vessels in this situation, passes out through the cervical fascia, which closes the upper part of the thorax, and thus reaching

the neck, diffuses itself along the sheaths of the arteries and nerves, along which it finds its way into the limbs; its appearance in which is first indicated by its extending along the course of the vessels.

The *symptoms of emphysema* are very distinctly marked. There is a puffy swelling, pale, and crackling when pressed upon, at first confined to the neighborhood of the wound, if there be one externally; if not, making its appearance opposite the fractured ribs, and gradually extending over the upper part of the trunk and neck, to which it is usually limited; in some cases, however, which are happily rare, the swelling becomes more general, the body being blown up to an enormous size, the features effaced, the movement of the limbs interfered with, respiration arrested, and suffocation consequently induced; after death air has been found in all the tissues, even under the serous coverings of the abdominal organs. In *traumatic pneumo-thorax* there is a diminution or complete absence of the respiratory murmur on the affected side, with a loud tympanitic resonance on percussion, puerile respiration in the sound lung, and considerable distress in breathing.

3d. *Pneumonia* is an invariable sequence of a wounded lung, and constitutes one of the great secondary dangers of these injuries; the inflammation that is necessary for the repair of the wound in this organ having frequently a tendency to extend beyond the part injured, and not uncommonly to terminate in abscess. Traumatic pneumonia resembles in all its symptoms, auscultatory as well as general, the idiopathic form of the disease. There is the same crepitation, dulness on percussion, and absence of respiratory murmur as hepatization advances; with rusty sputa, much tinged with blood in the early stages. It differs, however, from the idiopathic form of the disease, in having a less tendency to diffuse itself throughout the lung, in being limited to the injured side alone, and in more frequently terminating in abscess, which, however, is often dependent on the lodgment of some foreign body, such as a piece of wadding or clothing, in the substance of the organ.

4th. *Empyema* comes on at a later period, being usually occasioned by the irritation of effused blood, or of some extraneous substance that has lodged in the pleura. Its existence may be recognized by dulness on percussion, and absence of respiratory murmur at the lower and posterior parts of the chest up to a level that has a gradual tendency to ascend, and that varies according as the patient is upright or recumbent, until at last the whole side of the chest being filled with pus, there is increase of its size on measurement, with bulging of the intercostal spaces, and compression of the lung against the spine.

The *prognosis* in wounds of the lungs is of course extremely unfavorable, but less so than that of similar injuries of most of the other viscera. Gun-shot wounds of the chest are more dangerous than stabs, owing partly to the laceration attendant on a bullet-wound, but chiefly perhaps on the lodgment of foreign bodies that so commonly occurs in these injuries. Guthrie states, that more than half of those who are shot through the chest, die. After the battle of Toulouse, of 106 such cases, nearly half died; and of 40 cases at the Hôtel Dieu, 20 died. Messrs. Mouat and Wyatt state that of 200 cases of penetrating wounds of the chest occurring in the Russian army at the siege of Sebastopol, and treated at Simpheropol, only 3 recovered. The Russian surgeons, however, do not bleed in these cases, but use digitalis instead. The great danger and principal cause of death in these injuries is unquestionably the hemorrhage that ensues. This may prove immediately fatal if one of the larger pulmonary vessels is divided. As the bleeding is most abundant at, and shortly after the receipt of the wound, Hennen states that if the patient survive the third day, great hopes may be entertained of his recovery. After this period the chief source of danger is the occurrence of inflammation of the lungs and pleura, the extent and severity of which are greatly increased in gun-shot injuries by the frequent lodgment of foreign bodies within the chest. Emphysema is seldom

a dangerous complication, though it may become so if very extensive, and allowed to increase unchecked.

If both lungs are wounded at the same time, the result is almost inevitably fatal, either by the abundant hemorrhage suffocating or exhausting the patient; or else by the induction of asphyxia in consequence of air being drawn into both the pleural sacs, and thus by compressing the lungs, arresting respiration. This, however, does not necessarily result, and there are a sufficient number of cases on record of recoveries after stab or bullet wounds traversing both sides of the chest, to show that collapse of the lungs and consequent asphyxia does not necessarily result from this double injury, which indeed has also been determined experimentally on animals by Cruveilhier.

The *treatment* of wounds of the chest, implicating the lungs, must have reference to the various sources of danger that have just been indicated.

The local treatment is of a very simple character. If the wound have been made by a bullet, all foreign bodies that are within reach should be extracted. If there is any difficulty in doing this, it may be necessary to enlarge the aperture and then to remove them; but the surgeon must not go too deeply or perseveringly in search of them, lest he excite more irritation than the foreign body would. Light water-dressing should then be applied, no attempt being made to close the aperture, so that the escape of any extraneous substance that may have been left, or of extravasated blood, may not be interfered with.

If the wound be a clean puncture, the edges may be brought together and closed by means of stitches, plasters, and collodion, so that the bleeding may be arrested, and the patient enabled to breathe with more ease. It is seldom that there is any troublesome hemorrhage from wounds of the intercostal arteries; should there be so, the surgeon must enlarge the orifice of the wound, and secure the bleeding vessel in the best way he can.

Wounds of the internal mammary artery are of rare occurrence, considering its exposed situation. They may however occur if the chest is penetrated in front through the intercostal spaces, or costal cartilages. The danger in these cases is from the hemorrhage taking place slowly into the anterior mediastinum, or one of the pleuræ, without any external bleeding revealing the mischief that is going on within. If the wound of the vessel be ascertained, an attempt should be made, by enlarging the external aperture, to seize and ligature the bleeding ends, cutting directly down upon them through the injured intercostal space, or the vessel might even be followed beneath one of the costal cartilages, if necessary, by cutting through this. Should much blood have already been extravasated, this must be removed through the external wound, by the introduction of a female catheter, or by the application of a cupping-glass over it, and the case then treated like one of effusion into the chest.

In the constitutional treatment of these injuries, the first indication consists in diminishing the quantity of blood circulating through the lungs, and thus endeavoring to arrest the hemorrhage from these organs. With this view, a free venesection, to the extent of from at least twenty to thirty ounces, or even more, must be practised. In this way the bleeding may be stopped at once; should it recur, and the pulse rise, blood must be taken from the arm again and again. The most experienced surgeons are unanimous in their opinion, that at this stage of the injury, the patient's safety lies in free and repeated venesection. The patient must then be kept lying on the injured side, and have nothing but ice or barley-water allowed.

If the patient survive the third day, the danger to be apprehended is from inflammation within the chest. Here also bleeding must be practised, though it need not be done to the same extent as in the earlier stages of the injury. The inflammation must also be combated by a rigid diet, and by the administration of antimonials. In fracture of the ribs with wounded lung, the same line

of treatment requires to be adopted, but when the accident occurs in elderly people, we may advantageously substitute calomel and opium for the antimonials.

If extravasation of blood into the pleura is going on, its farther effusion must, if possible, be arrested by the same means that are adopted for the stoppage of external hemorrhage. When the bleeding has been checked in this way, the blood must early be let out from the pleural sac; for, if it be allowed to remain there, it will speedily putrefy, giving rise to extensive formations of pus in this cavity. In order to prevent these occurrences, the wound should be opened freely with a probe-pointed bistoury, on the fifth or sixth day after the injury, so that the blood may be discharged. If it do not readily come away, a cupping glass may be applied over the aperture, and thus it may be withdrawn. Should, however, the hemorrhage continue notwithstanding the employment of the means indicated, Guthrie advises that the wound should be closed, so that the blood that flows into the pleural sac may, by accumulating in this, compress the lungs, and thus arrest the further escape of blood from the wounded vessels; the patient at the same time should be made to lie on the injured side, in order to increase the pressure exercised upon the wounded and bleeding organ. On the sixth or eighth day the chest should be tapped, or the wound opened again, in order to evacuate the extravasation, and prevent its acting as an irritant to the pleura; or by permanently compressing and condensing the lung, rendering this useless.

In all cases of purulent effusion into the chest, Guthrie advises, with good reason, that tapping should be early performed, in order that the lung may not be bound down by false membranes, and consequently being unable to expand, lead to permanent flattening of the side, and impairment of respiration.

If any extraneous body, such as a bullet, a piece of wadding, or of clothing, have penetrated too deeply into the chest to be readily extracted through the external wound, it would not be safe to make incisions or exploratory researches, with a view of extracting it; for, though its presence would increase the patient's danger, yet, attempts at extraction would not only add to this, but in all probability be fatal. In many cases, bodies so lodged form an abscess around them, are loosened, and eventually are spit up, or appear at the external wound. In others, again, they remain permanently fixed in the chest, becoming enveloped in a cyst, and so remaining for years, without producing irritation. In this way Hennen states that a bullet has been lodged in the chest for upwards of twenty years; and Vidal mentions a man who lived for fifteen years with the broken end of a foil in his chest, which, after death, was found sticking in the vertebræ, and stretching across to one of the ribs.

The *treatment* of emphysema consists of little in addition to what is called for by the wounded lung. In many cases, indeed, the air becomes rapidly absorbed, without the necessity of any local interference. In others, again, the pressure of a bandage may be required. If, however, the emphysema be so extensive as to interfere with respiration, the external wound must be freely opened, and scarification made into the cellular tissue, so as to give exit to the air.

HERNIA OF THE LUNG, OR PNEUMOCELE.

Hernia of the lung is an affection of extremely rare occurrence. It consists in the protrusion of a portion of this organ at some part of the thoracic walls so as to form a tumor under the skin. It has most frequently been met with after an external wound, under the cicatrix of which the hernial swelling has appeared; but it has been known to occur from fractured ribs without any wound, and even from violent straining during labor. In these cases it is probable that the intercostal muscles and costal pleura having been divided or ruptured by the efforts of the patient, and not having united afterwards, the lung

has, during expiration, gradually insinuated itself into the aperture so formed, until at last the hernial tumor appeared.

This protrusion may take place at any part of the thoracic parietes: thus Velpeau has observed it in the supra-clavicular region of a girl; but most commonly it occurs on one or other side of the chest. The tumor may attain a large size; I have heard Velpeau state that he has seen one, half as large as the head. It does not appear to shorten life.

The only case that has fallen under my observation is one that I saw in 1839, in Velpeau's wards at La Charité: and, as the signs of the affection were well marked in this case I may briefly relate it, from notes taken at the time. A man twenty-nine years of age, left-handed, received in a duel, a sword wound at the inner side of, and a little below the left nipple; he lost a considerable quantity of blood, but did not spit up any, the wound healed in about a fortnight, shortly after which he found the tumor, for which he was admitted three months and a half after the receipt of the injury. On examination, an indurated cicatrix about half an inch in length was found a little below, and to the inner side of the left nipple. On inspiring or coughing, a soft tumor about the size of an egg appears immediately underneath the cicatrix, which it raises up; it subsides under pressure, or when the patient ceases to inspire or to cough; and its protrusion may be prevented by pressing the finger firmly on the part where it appears, when a depression is felt in the intercostal muscles. If the fingers are slid obliquely over the tumor, it yields a fine and distinct crepitation, exactly resembling that produced by compressing a healthy lung, and the spongy tissue of the organ can be distinguished. On applying the ear a fine crackling and rubbing sound is distinctly perceived; it is resonant on percussion. The portion of protruded lung does not appear to re-enter the chest on inspiration, but is firmly fixed in its new situation. No treatment was adopted in the case, nor does any appear admissible in similar ones.

The only affection with which a hernia of the lung can be confounded is a circumscribed empyema which is making its way through the walls of the chest. Here, however, the dulness on percussion, the absence of respiratory murmur, and of crackling under the fingers, will readily enable the surgeon to make the diagnosis.

It occasionally happens in extensive wounds of the chest that a portion of the lung protrudes during efforts at expiration. If the wound be free, the protruded lung may return on pressure, or during inspiration. If left unreturned, it soon becomes livid and gangrenous; under these circumstances it may be removed by the knife or ligature; but Guthrie advises that the protruded part should never be separated from the pleura costalis by which it is surrounded at its base, so that the cavity of the thorax may not be opened; the wound must then be closed in the usual way.

WOUNDS OF THE HEART AND LARGE VESSELS.

These injuries are generally immediately fatal from the sudden loss of blood and the nervous shock that the patient sustains. There are many cases on record, however, of persons that have walked or run some considerable distance after receiving a wound in the heart, before falling down dead. Olivier and Sanson have collected 29 cases of penetrating wounds of the heart that did not prove fatal in the first forty-eight hours after the receipt of the injury. On analyzing these, it would appear that the rapidity of death depends greatly on the direction of the wound and the part of the organ injured. When the wound is parallel to the axis of the heart it is not so speedily fatal as when in a transverse direction, and wounds of the auricle are more immediately followed by death than those of the ventricle; the irregular contraction of the different planes of muscular fibre that enter into the formation of the wall of the ven-

tricle tending to obstruct the free passage of the blood through the wound, and perhaps to close it entirely. The size of the wound, however, will necessarily influence the result more materially than its direction. Without referring to numerous cases recorded by the older surgeons, there are a sufficient number of instances reported by modern writers to prove that an individual may live for many days, and even recover altogether from the effects of a wound by which the cavities of the heart have been penetrated, although with a foreign body lodged in them. Thus Ferrus relates the case of a man who lived for twenty days with a skewer traversing the heart from side to side. Messrs. Davis and Steward found a piece of wood, three inches long, in the right ventricle of a boy, who lived five weeks after the accident had happened; and Latour records the case of a soldier, who lived for six years after being wounded with a musket-ball in the side, and in the right ventricle of whose heart the bullet was found lodged, lying against the septum.

From the inquiries of Olivier it would appear that the right ventricle is more frequently wounded than the left; next, the apex or base of the heart, then, the right auricle, and least frequently, the left auricle.

The *signs* of an injury of the heart that is not immediately fatal, are not very positive. The hemorrhage, the direction of the wound, the dyspnœa, the extreme anxiety, syncope, and irregularity with smallness of the pulse, indicate the probable nature of the mischief. The most important information, however, is to be derived from auscultation; the occurrence of friction, or some other abnormal sound, with absence of impulses, and increased dulness on percussion over the region of the heart, may point to the seat of the injury.

The pericardium may be injured without the heart being wounded; by stabs, by gun-shot violence, or severe contusions of the chest. In injuries such as these, inflammation is set up, and the ordinary auscultatory signs of pericarditis, such as friction or creaking sounds, with dulness on percussion, are distinctly perceptible. When blood is effused into the pericardial sac, these morbid sounds may be absent, but the heart's impulse is weak, and the circulatory sounds distant, the layer of blood preventing, as Mr. Guthrie has pointed out, the contact of the cardial and pericardial surfaces.

Ruptures of the heart from external violence, without penetrating wound of the chest, are not of frequent occurrence. Mr. Gamgee has, however, collected 27 published cases of this accident. On analyzing these he finds that, in at least one half of the cases the pericardium was intact; 12 of the ruptures were on the right, 10 on the left side. The *right* ventricle was ruptured in 8, and the left in 3 cases; whereas the *left* auricle was torn in 7, and the right in only 4 instances. Death is usually nearly instantaneous, though there are instances on record in which the patient has made some exertion after the rupture had taken place, and has even lived for several hours. In a case of rupture of the right auricle recorded by Rust, the patient survived fourteen hours. The only case that has occurred in my practice was that of a man brought into the hospital dead, having fallen from the top of a cart. The right shoulder was bruised and the clavicle broken — showing clearly that he had pitched on that side; there was no other bruise about the body, or evidence that the wheels had passed over him. On examination, the liver was found extensively torn, in fact smashed, and the pericardium was distended with blood—there being a triangular ragged aperture at the anterior part of the auricular appendage of the left auricle, through which it had escaped.

Wounds of the *aorta* and *vena-cava* are as fatal as those of the heart itself. Dr. Heil has, however, recorded a case in which a patient recovered, and lived for a twelvemonth, after receiving a stab that penetrated the ascending aorta.

CHAPTER XXI.

INJURIES OF THE ABDOMEN AND PELVIS.

Injuries of the abdomen are of frequent occurrence. They may be divided into *contusions* of the abdomen, with or without rupture of internal organs; into *non-penetrating wounds*, and into *penetrating wounds;* either uncomplicated, or conjoined with injury or protrusion of some of the organs contained in this cavity.

Contusions of the abdominal walls from blows or kicks, usually terminate without serious inconvenience, but in some cases are followed by peritonitis of a very acute character, which may prove fatal.

In other cases again, the abdominal muscles may be ruptured, although the skin may remain unbroken. A man was admitted under my care into the hospital, who had received a blow from the buffer of a railway carriage upon his abdomen, he complained of great pain at one spot, and on examination after death, we found the rectus muscle torn across without injury either to the integuments or the peritoneum. If the patient live, an injury of this kind is apt to be followed by atrophy of the muscular substance, and perhaps by the occurrence of a ventral hernia at a later period. Occasionally the contusion is followed by abscess in the abdominal wall, which has a tendency to extend widely between the muscular planes. These abscesses should be opened early, lest they burst into the peritoneal cavity and occasion fatal inflammation.

A contusion of the abdomen is often associated with *rupture* of some of the viscera. In military practice these internal injuries are met with in the so-called "wind-contusions;" in civil practice they commonly result from blows, kicks, the passage of a cart-wheel over the abdomen, or the squeeze of the body between the buffers of two railway carriages. These "*Buffer-accidents*" are now of common occurrence in hospital practice, resulting usually from the carelessness of railway guards and porters, who, trying to pass between carriages in motion, are caught and squeezed between the buffers. In these cases the most fearful internal injuries occur, often without an external wound. A man was admitted under my care into University College Hospital, in whom the liver, stomach, spleen, and kidneys, were crushed and torn; the heart was bruised, being ecchymosed on its surface, and one of the lungs lacerated, without there being any rupture or bruise of the skin, or fracture of the ribs. In this way any of the abdominal organs may be torn or contused, the particular one injured depending on the situation of the blow. The organ that is most frequently crushed in this way is the liver, owing to its large size and the ready lacerability of its structure; the other solid organs, such as the spleen and kidneys, not suffering so frequently: the pancreas I have never seen injured. Amongst the hollow organs the stomach most commonly suffers, and it is especially likely to do so if distended by a meal at the time that it is struck. Any portion of the intestinal canal may be lacerated. I have seen the duodenum, the ileum, the jejunum, and the large intestine ruptured in different cases: the mesentery likewise may be torn and the spermatic cord snapped across.

The sufferer usually dies in the course of a few hours, or at the utmost at the end of two or three days after the receipt of these injuries, from hemorrhage into the abdominal cavity, conjoined with shock to the system. It is seldom that life is prolonged sufficiently for peritonitis to be set up, though this is the chief danger to be apprehended in those cases that survive the more immediate effects of the accident. When the solid organs are ruptured, death most commonly ensues from hemorrhage. The shock in itself may prove fatal, though

there be but little internal mischief done; thus, I have seen a man die collapsed eight hours after a buffer accident, in whom no injury was found except a small rupture of the mesentery, attended with but very slight extravasation of blood. It does not follow, however, that these injuries are necessarily fatal. Patients have lived after all the signs of rupture of the liver or the kidneys, passing bloody urine, and having circumscribed peritonitis, and when death has occurred, at a later period cicatrices have been detected in these organs; this indeed is nothing more than has been met with in ordinary penetrating wounds of the abdomen. A patient was admitted into the University College Hospital for a severe blow upon the back, accompanied by symptoms of renal injury; on his death from other causes, nine weeks after the accident, an extravasation of blood, with the marks of recent cicatrisation, was found in the left kidney.

Rupture of the liver is by no means invariably speedily fatal. It may be so from great extravasation of blood, but when this is not largely poured out the patient may live for some considerable time. A man was admitted last year under my care into University College Hospital, who had been crushed between the buffers of two railway carriages. He was collapsed, and apparently moribund, but rallied in a few hours. Two days after the accident, great pain and tenderness in the right hypochondrium were complained of, and dulness on percussion was found to extend as low as the umbilicus. He became jaundiced, and there were symptoms of low peritonitis; these were followed by great swelling of the abdomen, which became tympanitic; the peritonitis continued, and symptoms of intestinal obstruction came on, the dulness increasing, with fluctuation in the flanks. He died on the sixteenth day after the accident, and, on examination, no less than 240 oz. of bilious fluid, mixed with flakes of lymph, were found in the abdominal cavity; the obstruction being dependent on the pressure of this effusion, and on the matting together of the intestines by lymph. There was a large rent found in the thick border of the liver, which was beginning to cicatrise.

The *symptoms* of an internal abdominal injury are often extremely equivocal. If the liver or spleen have been lacerated, there will be all the effects of severe shock to the system, accompanied by those of internal hemorrhage; coldness, and pallor of the surface, a small and feeble pulse, anxiety of countenance, and great depression of the vital powers, with pain at the seat of injury, and perhaps dulness on percussion, from extravasated blood; symptoms that speedily terminate in the death of the patient. If the kidneys are injured, the patient will commonly experience a frequent desire to pass water, and this will be tinged with blood, often to a considerable extent. The absence of blood in the urine must not, however, be taken as an indication that the kidney is not injured; it may be so disorganized as to be totally incapable of secreting, and consequently no bloody urine finds its way into the bladder. A man was admitted into the hospital under my care for a buffer-injury of the back; he passed water untinged with blood, but after death his right kidney was found completely smashed by the blow, with an extensive extravasation of blood in the cellulo-adipose tissue around it; here it was evident that the disorganization was so sudden and complete, that no bloody urine had found its way into the bladder.

When the stomach is ruptured, it commonly happens that the nature of the accident is revealed by bloody vomiting; and when the intestines have been torn, by the admixture of blood with the stools, if the patient lives long enough to pass any. These signs, however, do not occur in all cases. A man was admitted into the hospital under my care, whose abdomen had been squeezed between a cart-wheel and a lamp-post; during the five hours that he lived after the accident, he vomited several times, bringing up a meal that he had taken immediately before. In the vomited matters there was no blood to be seen, but

on examination after death it was found that the liver and spleen were not only ruptured, but the stomach torn almost completely across near the pylorus.

Emphysema of the abdominal wall, and subsequently of the trunk generally, may result from the escape of flatus from a wounded intestine into the subperitoneal cellular tissue, and thence into the more superficial cellular planes. When this takes place, the same doughy, puffy, inelastic, crepitating swelling of the subcutaneous cellular tissue, that is met with in the thoracic form of the affection is observed. The emphysema usually commences in one or other flank, and may then creep on up towards the axilla, or in front of the abdominal wall.

As a diagnostic sign, this form of emphysema is valuable in those cases in which the intestines have been injured, either without any wound of the abdominal parietes, or if there be wound, without protrusion of the injured portion of gut. In two cases in which I have observed it, this condition was the only positive sign of intestinal injury. In one case, the transverse duodenum had been ruptured where uncovered by peritoneum, by a buffer-accident; and in the other, the rectum and meso-rectum had been traversed by a pistol-ball. In both these cases the emphysema was extensive, the flatus having directly passed into the subperitoneal cellular tissue. In other cases it may do so more indirectly by having, in the first instance, passed into the cavity of the abdomen, and rendered that tympanitic; and so, as in thoracic emphysema from pneumothorax, escaped from this into the cellular tissue at the edges of the wound.

The diagnosis of abdominal emphysema requires to be made from thoracic emphysema, and from putrefactive infiltration of air in the cellular tissue. In the first case it may readily be effected by observing an absence of the signs of thoracic injury, and by the situation of the emphysema in the posterior or lateral abdominal wall, or around the lips of a wound. From putrefactive emphysema the cause, and the absence of low inflammation of the cellular tissue, renders the diagnosis easy.

The *treatment* of the various injuries of the abdomen that have just been described is of a very simple character. If the symptoms indicate laceration of one of the viscera, little can be done during the state of collapse supervening on the accident, beyond keeping the patient quiet, and employing the means that have been recommended for lessening the effects of shock upon the system. If the patient survive this period, we must guard against the supervention of peritonitis, and limit, if possible, the extravasation of blood into the abdomen, should there be indications of its occurrence, by the employment of treatment that will presently be described.

Wounds of the abdominal wall that do not penetrate the peritoneal cavity, if uncomplicated with internal injury, usually do well, and require to be treated on ordinary principles. If incised, and so extensive as to require sutures, the stitches should only be introduced through the skin, never through muscular or tendinous structures, the union of which could not be effected in this way; the parts injured must also be relaxed by careful attention to position.

Wounds that penetrate the cavity of the abdomen are of especial interest, on account of the frequency with which they are complicated with peritonitis, and with injury of some of the viscera. They may, for practical purposes, be divided into those that penetrate the peritoneal sac, without wounding or causing the protrusion of any of the contained organs, and those that are complicated with protrusion, or wound of some of the viscera.

1st. Penetrating wounds of the abdomen *without visceral protrusion or injury*, are somewhat difficult to distinguish from simple wounds of the abdominal wall, though the escape of a small quantity of reddish serum may reveal the nature of the accident. In these cases the surgeon should be careful not to push his examination too far, by probing, or otherwise exploring the injury. In the ab-

sence of peritonitis or other signs of mischief, he must treat it as a simple wound of the abdominal wall, and should any complication occur, must meet that in the way that will immediately be described.

2d. In a penetrating wound *with protrusion or injury of the viscera*, the risk is necessarily greatly increased; here the chief danger is from peritonitis, induced either by the wound, — by the extravasation of the intestinal contents into the peritoneal cavity, or by the accumulation of blood in it. It but seldom happens that death results from hemorrhage in these cases, though this may, of course, occur if any of the larger vessels be injured.

3d. Protrusion of uninjured intestine, mesentery, or omentum, may take place through the wound in the abdominal wall. This protruded mass is always of very large size in comparison with the aperture from which it escapes, the sides of which being overlaid by it, constrict it pretty tightly, so as to form a distinct neck to the protrusion. If left unreduced, the mass speedily loses its polish and bright color, becoming dull and livid from congestion; it then inflames, and soon becomes gangrenous from the pressure exercised upon it by the sides of the aperture through which it has passed.

4th. In many cases the protruded intestine is wounded. The existence of this further injury will readily be ascertained, by the escape of flatus, or of the more fluid contents of the gut. The characters of the wound vary, as Travers has pointed out, according to its size. If it be a mere puncture in the gut, or even an incision two or three lines in length, an eversion or prolapsus of the mucous membrane will take place, so as to close it to an extent sufficient to prevent the escape of its contents. If the aperture be above four lines in length, this plugging of it by everted mucous membrane cannot take place, and then the contents of the bowel are more freely discharged; but, even under these circumstances, there will be a tendency to the protrusion of the membrane, which forms a kind of lip over the edge of the cut.

5th. A wounded intestine which does not protrude, but remains within the peritoneal sac, presents the same conditions. In these cases, however, there is the additional danger of the extravasation of the intestinal contents into the peritoneal cavity. This *extravasation of feculent matter*, unquestionably one of the greatest dangers that can occur in wounds of the abdomen, inasmuch as by its irritating qualities it gives rise to and keeps up the most intense peritonitis, takes place less frequently than might be expected. For this there are several reasons. In the first place, we have already seen, that, if the wound in the gut be below a certain size, there is a natural tendency to its occlusion by eversion of the mucous membrane into it. Besides this, it must be borne in mind that, though in ordinary language we speak of the "cavity" of the abdomen, there is in reality no such thing; there being no empty space within the peritoneal sac into which extravasated matters could fall, but the whole of the visceral contents of the abdomen being so closely and equably brought into contact by the pressure of the abdominal muscles and of the diaphragm, that it requires some degree of force for the intestinal contents to overcome this uniform support, and to insinuate themselves between the coils of contiguous portions of intestine. The influence exercised by the continuous pressure of the abdominal walls upon the intestinal contents, is well shown by the greater facility with which these escape from a portion of wounded intestine that has been protruded, than from one that is still lying within the abdomen. In the former case, fæces will escape from a much smaller aperture than in the latter instance, in consequence of the gut not being supported on all sides by the uniform pressure to which it is subjected within the abdomen. It is seldom, indeed, that fæces are extravasated from gut that is not protruding, unless it be very full at the time of the injury, or the wound in it be very extensive. The influence of the equable pressure of fæces was well illustrated in a case in University College Hospital, of a man who was shot through the abdomen. The intestines, which

contained much feculent matter, were traversed by the bullet in four places. He lived twenty-four hours, and yet no feculent extravasation took place.

Blood is extravasated more readily than the intestinal contents in wounds of the abdomen. This is in a great measure owing to the *vis-a-tergo* influence existing in an artery of moderate size, such as one of the branches of the mesenteric, being sufficient to overcome the equable pressure and support of the abdominal walls.

These extravasations, whether of fæces or of blood, when once formed have little tendency to diffuse themselves, but become localized in the neighborhood of that part from which they were originally poured out, owing, in the first instance, to the surrounding pressure, and, at a later period, to the deposit of plastic matter between the folds of intestine and neighboring viscera. In this way the diffusion of irritating matters through the abdominal cavity being prevented, the likelihood of the occurrence of wide-spread and fatal inflammation is much diminished.

The existence of these extravasations may, in many cases, be recognized by dulness on percussion around the wound, by the localized swelling to which they give rise, and, sometimes by their escape through the external aperture.

In *the treatment* of penetrating wounds of the abdomen, we must first consider the management of the injured parts; and, afterwards, the prevention or cure of the consecutive peritonitis.

If the wound have not implicated any of the abdominal viscera, it must be closed by relaxing the abdominal muscles by position, by introducing a few points of suture through the integuments, if it be extensive, and by applying a compress and plaster, supported by a bandage. The patient should then have a full dose of opium given him; about 2 grains of solid opium or 40 minims of the liquor sedativus, which must be repeated in from four to six hours, so that the effects may be kept up. He should then be kept perfectly quiet in bed, and no nourishment given for a few days, except barley-water and ice. The bowels should not be opened by aperient medicine, lest abdominal irritation be set up, but oleaginous enemata may be administered at the end of a week or ten days.

If the intestine be wounded but not protruding, we must endeavor to limit the peritonitis that will ensue, and also to prevent feculent extravasation. With this view the patient should be laid on the injured side with the wound dependent, so as to allow the fæces to escape through it if disposed to do so. If the injury be about the umbilicus he must lie upon his back with the knees drawn up and bent over a pillow. Opium must then be administered in the full doses already indicated, and repeated in grain doses at least every fourth or sixth hour, so that the system be kept well under its influence. The value of opium in these cases is very great; it not only seems to moderate the inflammation that takes place in the peritoneum, but is of the greatest utility in preventing extravasation of fæces. This it does by arresting the peristaltic movements of the intestine, and thus, by keeping it from change of position, lessening the chance of the escape of its contents. This arrest of the intestinal movements also tends greatly to the closure of the wound. Travers has shown experimentally, and his investigations have been confirmed by subsequent observations on the human subject, that wounds of the intestines are closed by lymph that is thrown out, not only from the contiguous peritoneal surfaces of the part actually injured, but from that of neighboring coils; so that the aperture in the gut becomes permanently glued and attached to the structures in its vicinity. In order that this process should take place, it is necessarily of the first importance that the movements of the bowel be paralyzed; and it is a beautiful provision of nature that the very inflammation which closes the wound, arrests that peristaltic action, the continuance of which would interfere with its agglutination to, and closure

by, the neighboring parts. Until the necessary degree of inflammation to effect this is set up, the intestinal movements must therefore be arrested by opium.

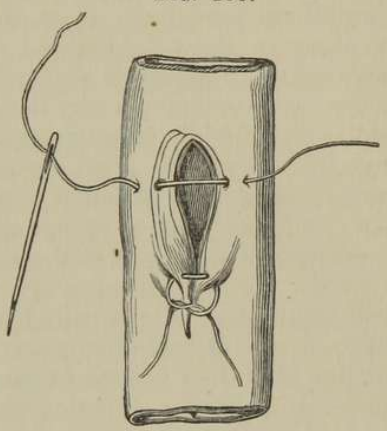
If extravasation of feculent matter have taken place into the cavity of the abdomen, an attempt might be made to facilitate its escape by removing the stitches and plasters from the external wound, and placing the patient on the injured side, so that this may be in the most dependent position; should the lips of the wound have already become adherent to one another, they might even be gently and carefully separated by the introduction of a probe, and in this way an outlet afforded the effused matters.

When a portion of intestine or of omentum has protruded, it should be replaced as speedily as possible, before strangulation has occured to occasion gangrene of the protruded mass. In order to effect reduction, the abdominal muscles should be relaxed by bending the thigh upon the abdomen, when the surgeon may gradually push back the protrusion by steady pressure upon it; no force must, however, be had recourse to, or any rough handling of the exposed and delicate parts; but if it be found that their return cannot readily be effected, owing to the constriction of the neck of the tumor, the aperture through which they have escaped must be carefully enlarged, in a direction upwards, by means of a probe-pointed bistoury, or a hernia-knife, guided by a flat director. The incision necessary to enlarge the opening sufficiently to admit of reduction, need not exceed half-an-inch in length. In replacing the protruded parts, whether by the aid of incision, or not, care must be taken that they are fairly put back into the cavity of the abdomen, and not pushed up into the sheath of the rectus, or into the subserous cellular tissue lying before the peritoneum; an accident that would be fatal by allowing the constriction of the neck of the protrusion to continue unrelieved. In effecting the return the surgeon should not push his finger into the cavity of the abdomen, but must content himself with simply replacing the protruded gut, or omentum, and allowing it to remain in the immediate neighborhood of the wound in the abdominal wall, to which it will contract adhesions; and through which its contents may escape, in the event of any sloughing action being set up in it. If the protrusion be inflamed, it must equally be replaced without delay; but should the intestine have become gangrenous from continued constriction and exposure, no attempt at reduction should be made, but an incision must be carried through it, so as to allow of the escape of fæces, and the formation of an artificial anus. If the protruded omentum be gangrenous, it must be excised on a level with the peritoneum, to the aperture in which that portion lying within the abdomen will have contracted adhesions.

If the intestine that protrudes be wounded, the treatment of the aperture in the gut will call for special attention; and surgeons have been somewhat divided as to the line of practice that should be pursued in such a case. The question that has been left open is, as to the propriety of stitching up the wound of the intestine. Scarpa and S. Cooper were opposed to this practice on the ground that it does not prevent extravasation, and that the stitches produce irritation by acting as foreign bodies. They proposed to return the wounded gut, taking care, however, to leave the aperture in it to correspond with that in the abdominal wall, so that an artificial anus might be established by the cohesion of the edges of either opening to one another, these adhesions preventing extravasation. To this practice the great objection exists that extravasation will probably occur before there has been time for the effusion of lymph, and the agglutination of the contiguous surfaces; besides which, it is impossible to secure the necessary correspondence between the two apertures, the wounded gut being very liable to alter its position after it has been replaced. It has also been found by experience that one of the objections urged against the employment of a suture, that it cannot prevent the escape of feculent matter, is not valid. If it be properly applied, it may effectually do so, as was shown by a

successful case under my care, the details of which have been published in the "Lancet," for 1851. That the stitches act as sources of irritation to any serious extent is also doubtful. Travers found by experiment that when a wounded gut was sewn up, and returned into the abdomen, the sutures quickly became bridged or coated over with a thick layer of lymph, and gradually ulcerating their way inwards, at last dropped into the cavity of the intestine, being discharged *per anum*, and leaving a firm cicatrix at the point to which they had been applied. For these various reasons, Guthrie, Travers, and other surgeons of experience, advocate the practice of stitching up a wounded and protruding intestine, with which opinion I entirely agree. Much, however, depends upon the way in which the sutures are applied. They should be introduced by means of a fine round needle, armed with sewing silk, in such a way that the peritoneal surfaces on either side of the wound alone are brought into contact as adhesion takes place solely between them, the wound in the other structures of the gut filling up by plastic deposit. It has been recommended that the needle should only penetrate the peritoneal and cellular coats, no muscular tissue being taken up in it, lest retraction of the included fibres, by dragging upon the stitches, might re-open the wound. This, however, it is extremely difficult to do. The safer plan is doubtless to carry the suture through the whole thickness of the gut, bringing the stitches out at about the one-sixth of an inch from the edge of the cut, from each other, in such a way that the serous surfaces are drawn into apposition (fig. 133). The kind of suture that should be used is the "glover's stitch." When the lips of the wound have been nearly brought into apposition in this way, it has been proposed to leave the end of the thread hanging out of the aperture of the abdominal wall, and to withdraw it when it becomes loose; but I think it better not to leave it, as it might induce great irritation, acting like a seton in the peritoneal cavity. It is better, therefore, to cut the ends short close to the knot, when the suture will eventually become covered with lymph, and find its way into the inside of the gut by ulcerating through the muscular and mucous coats.

Fig. 133.



After the aperture in it has been thus closed, the protruded portion of the intestine must be reduced, having previously been properly cleansed with a little lukewarm water. The reduction must be effected in the way that has already been described, the surgeon being especially careful not to push the wounded coil of intestine far into the abdomen, but to leave it close to the external orifice, so that in the event of extravasation occurring, or the stitches giving way, a ready outlet may be afforded. Should the wound in the abdominal wall be extensive, it must be closed by means of sutures and plasters, supported by a bandage, the inferior angle being left open to allow of the escape of extravasation. The wound in the peritoneum had better be left; but should it be very extensive, the practice that was successfully adopted under such circumstances by Mr. Wood, of stitching up the aperture in it, might be had recourse to. The after-treatment must be conducted in all respects on the same principles that guide us in the management of an intestine that has been wounded without protruding. Care must be taken, by attention to the position of the patient, and by the free administration of opium, to keep the bowel as quiet as possible near the external opening; the urine should be drawn off twice in the twenty-four hours, and no purgative whatever administered, lest by

the excitation of peristaltic action, adhesion be disturbed and extravasation take place. After the lapse of six or eight days, an enema may be thrown up, and repeated from time to time. No food should be allowed for the three first days, during which time tea and barley-water should be freely taken; after this, beef-tea and light food that leaves no residue may be administered.

Traumatic peritonitis is the great danger to be apprehended in all these injuries of the abdomen, and it is by inducing this that extravasation of fæces or of blood so frequently proves fatal. It is true that a certain degree of inflammation of the peritoneum is necessary for the healing of all abdominal wounds, but it must be limited in extent and plastic in character. It is the more diffuse form of peritonitis, attended by the exudation of turbid serum, and shreddy, ill-conditioned lymph, that is so speedily fatal. In these cases, we meet with the ordinary symptoms of the idiopathic form of this affection; — uniform tenderness about the abdomen, with much tympanitis, more particularly in the neighborhood of the injury, with occasional stabbing pains, followed by tympanitic distension, vomiting, and hiccup, a small, quick, hard pulse, often assuming a wiry incompressible character, with considerable pyrexia, and great anxiety of countenance. The traumatic peritonitis will set in and run its course with great rapidity; in a case in University College Hospital, already alluded to, of bullet wound of the abdomen, the patient lived 24 hours. Two or three pints of serous effusion with much puro-plastic matter, and great reddening of the whole of the visceral and much of the parietal peritoneum had ensued. As the inflammatory extravasation increases, dulness on percussion will manifest itself — usually first on the flanks, and then gradually extending forward until it may occupy a great extent of surface in the abdomen. In the treatment of this disease we must be guided by the character of the inflammation. If it be of a sthenic form, and the patient young and robust, he should be bled freely in the arm, and have leeches abundantly applied over the surface of the abdomen; a pill composed of two grains of calomel and one grain of opium may then be administered every sixth hour, or oftener, if the patient be not influenced by the narcotic; and rigid abstinence from all except ice and barley-water should be enforced. If the peritonitis be the result of a wounded intestine, it is safer to omit the calomel, using mercurials instead to the inside of the thighs, but giving opium freely. When the peritonitis occurs in an old or feeble subject, our principal trust must be in the administration of opium and free leeching of the abdomen, followed perhaps by a blister, which may be dressed with mercurial ointment. In these cases, however, early support will be required, with perhaps the administration of wine or stimulants. The inflammatory extravasation will gradually be absorbed under the influence of the calomel, aided by blisters.

INJURIES OF THE PELVIC VISCERA.

Rupture of the bladder, from blows upon the abdomen, or penetration of it by bullet wounds, is not of very unfrequent occurrence, and is especially liable to happen if this organ be distended at the time it is struck, when very slight degrees of accidental violence, as running against a post, falling off a bed, may occasion its rupture. The *effects* of these injuries vary considerably, according to the part that has given way or been wounded. If the laceration have occurred in those portions of the viscera that are invested by peritoneum, the urine will at once escape into the pelvic and abdominal cavities, and speedily occasion death by the intense irritation and inflammation set up by it. I have, however, seen a case in which, even under these circumstances, the patient survived ten days. If, on the other hand, that portion of the organ have been ruptured which is uncovered by peritoneum, the urine will infiltrate into the cellular tissue between this membrane and the abdominal wall, and diffusing

itself widely, produce destructive sloughing of the tissues amongst which it spreads. In these cases life may be prolonged for some days, when the patient commonly sinks from the combined irritative and inflammatory action. Still, however, it must be borne in mind, that numerous cases of injury of the bladder, more especially from gun-shot wounds, have recovered, and that, although we must look upon this accident as of the gravest character, yet that it cannot be considered as being necessarily fatal.

The *symptoms* of a ruptured bladder are sufficiently evident; the injury in the hypogastric region, followed by collapse, by intense burning pain in the abdomen and pelvis, with inability to pass the urine, or, if any have escaped from the urethra, its being tinged with blood, are usually sufficient to point to the nature of the accident. If in addition, it is found, on introducing a catheter, that the bladder is empty, or that but a small quantity of bloody urine escapes, the surgeon may be sure that this organ has been burst. In the case of gun-shot injury, the escape of urine, which generally takes place through the track of the bullet, will afford incontestable evidence of the mischief that has been produced.

In the *treatment* of these cases, the most important indication is the prevention of further extravasation by the introduction of a full-sized elastic catheter into the bladder, which must be left there, so that the urine may dribble away through it as fast as it accumulates. If any sign of extravasation makes its appearance, free and deep incisions should be made into the part, so as to facilitate the early escape of the effused fluid and the putrid sloughs. I cannot but consider all active antiphlogistic treatment as out of place in these injuries, never having seen the slightest benefit from their employment. The only chance that the patient has, if once extensive extravasation have occurred, is that there may be sufficient power left in the constitution to throw out a barrier of lymph that will limit the diffuse and sloughing inflammatory action set up, and the prospect of this would certainly not be increased by the employment of depletory measures. There will also be so great a call upon the powers of the system at a later period, after sloughing has fairly set in, that a supporting or even stimulating plan of treatment would rather be required.

Foreign bodies, such as pieces of catheters, tobacco-pipes, pencils, &c., are occasionally met with in the urinary organs, having been introduced through the urethra. In some cases they are soon spontaneously expelled, but more usually they require extraction; sometimes they may be fortunately seized with a small lithotrite or urethral forceps in the direction of their long axis, and thus extracted; but more frequently they require to be removed through an incision made into the bladder. This is more safely done by the mesial, rather than by the lateral operation of lithotomy.

It occasionally happens that musket-balls, pieces of clothing, &c., have been lodged in the bladder in gun-shot wounds of that organ. These speedily become incrusted with urinary deposits, and giving rise to the symptoms of stone in the bladder, require to be removed by lithotomy, an operation that has proved very successful in these cases, evidently in consequence of the healthy condition of the urinary organs. Mr. Dixon has collected from various works the details of 15 cases, in which balls that had either primarily entered the bladder or found their way into this organ by abscess or ulceration after being lodged in the neighborhood, had been extracted by operation. In 10 of these cases the result was successful; in the remaining 5 no record is made of the termination.

Mr. Stanley has related a remarkable case in which the ureter was ruptured by external violence, and in which the patient recovered; a very large accumulation of fluid forming on the injured side of the abdomen, with considerable circumscribed tumefaction and fluctuation, and which required repeated tapping. In another case in which the pelvis of the kidney was ruptured, a similar col-

lection of urine took place within the abdomen, requiring tapping; as much as six pints being removed at one sitting. On examination after death, which occurred on the tenth week from the accident, a large cyst was found behind the peritoneum, communicating with the pelvis of the kidney.

Laceration of the urethra not uncommonly happens from kicks on the perineum, or in consequence of falls from a height, the patient coming astride upon a girder or a plank of wood, and rupturing the urethra at the triangular ligament. In these cases there is great bruising, and sometimes wound of the perineum, and if an attempt have been made to pass water, the patient will find himself unable to do so, the effort being also accompanied by deep and burning pain, followed perhaps by the discharge of blood or a few drops of bloody urine from the urethra. The consequences of this injury are often most disastrous. The immediate result is usually extravasation of urine into the perineum, which, if not checked by proper treatment, rapidly passes forward through the scrotum up upon the abdomen, giving rise to extensive sloughing of every portion of cellular tissue with which it comes in contact, and leading perhaps to the rapid destruction of the integuments of these parts, and the consequent formation of extensive and deep abscess and ulceration. If the patient recover from this mischief, he will very likely do so with a fistulous opening in the perineum, and ultimately suffer from a very intractable form of stricture, which in some cases may be completely impassable, in consequence of a portion of the urethra having been torn across and sloughing away.

The *treatment* of this injury consists in the early introduction of a catheter into the bladder. If this can be done before the patient has made an attempt at passing his urine, much of the immediate danger of the case may be averted, by the prevention of urinary infiltration. The catheter, which should be an elastic one, must be left in the bladder for a few days. If any hardness, throbbing, or other sign of irritation occur in the perineum, free incision should be made into the part, so as to afford a ready outlet for any urine that may have been effused. If the surgeon find it impossible to get a catheter into the bladder, the urethra being torn completely across, he should pass it as far as it will go, and then putting the patient in the position for lithotomy, make a free incision in the mesial line, upon the point of the instrument, so as to make an opening in the perineum communicating with the deeper portion of the urethra, or he might puncture through the rectum if the bladder be distended; but it is best to get a free outlet for the urine through the perineum, if possible. As the urine becomes extravasated, the surgeon must follow its course with free and deep incisions, supporting the strength of the patient at the same time by a due allowance of stimulus and nourishment. If, when the urethra is completely torn across, the urine finds a difficulty in escaping, and relief is not afforded by the perineal incision, the bladder becoming distended, it should be tapped through the rectum, in the way that will be described when we come to speak of diseases of the urinary organs.

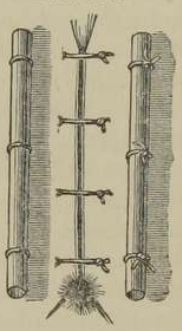
Foreign bodies are occasionally impacted in the vagina or rectum. A variety of things, such as pieces of stick, glass bottles, gallipots, &c., have been introduced into these canals. Their extraction is often attended with great difficulty, in consequence of the swelling of the mucous membrane over and around them, and the depth to which they have been pushed. In order to remove them, lithotomy or necrosis forceps may be required. In some cases, the foreign body has been found to transfix the wall of the canal in which it is lodged, and by penetrating the peritoneum, has speedily occasioned the patient's death. A remarkable case of this kind has recently occurred in my practice, in which a cedar pencil, five inches long, and cut to a point, had been forced up through the posterior wall of the vagina of a young woman into the abdominal cavity. Here it transfixed two coils of the small intestine, and after a sojourn of eight months was extracted by an incision through the anterior abdominal wall, mid-

way between the umbilicus and Poupart's ligament, where its point was engaged in the fascia transversalis. It had occasioned repeated attacks of peritonitis, and after its extraction death resulted from that cause.

Laceration of the Perineum.—The perineum is occasionally ruptured during parturition. When the laceration is of limited extent and recent, union may usually be effected by bringing and keeping the thighs together immediately after its occurrence. Should the lacerations have existed for some weeks, but not extend into the sphincter ani, it may usually readily be repaired by paring the edges freely, and passing two deep quilled sutures so as to bring the opposite sides together.

When the laceration is very extensive, extending through the posterior wall of the vagina, the perineum, the sphincter ani, and the rectum, in fact tearing through the recto-vaginal septum, more energetic and careful treatment will be required. The bowels having been well cleared out, and the patient being placed in the position for lithotomy, the edges and sides of the rent must be freely and deeply pared. The sphincter ani should then be freely divided on either side of the coccyx, as recommended by Mr. Brown, in order that its action may be paralyzed and all tension of the parts removed. Three points of quilled suture should then be deeply passed through the freshened sides of the laceration, and the edges brought together by a few points of interrupted suture (fig. 134). The success of the operation will entirely depend on the attention bestowed on the after treatment of the case; the mode of conducting this has been laid down with much precision by Mr. Brown. The principal points to be attended to are as follows:—Immediately after the operation, a full dose of opium should be given, and a grain administered every sixth hour with the view of arresting all intestinal action. The patient should be laid on her side, and a catheter retained so as to prevent any dribbling of urine over the raw edges, which would be fatal to their union. The deep sutures should be left in for four or five days, the superficial ones for about a week; during this period I have found it advantageous to keep the part covered with collodion. When the sutures are removed, a pad of dry lint, supported by a T bandage, should be applied. The bowels should not be allowed to act for at least ten or twelve days, lest the freshly united surfaces be torn through. During the whole of this period the patient's strength must be supported by good diet, and scrupulous attention paid to the cleanliness of the parts. Plastic operations of this kind should not be performed unless the patient is in a good state of health.

Fig. 134.



CHAPTER XXII.

EFFECTS OF HEAT AND COLD.

BURNS AND SCALDS.

A burn is the result of the application of so great a degree of heat to the body as to produce either inflammation of the part to which it is applied, or charring and complete disorganization of its tissue. A scald is occasioned by the application of some hot fluid to the body, giving rise to the same destructive effects that are met with in burns, though differing from them in the appearances produced.

Local effects.—Burns and scalds vary greatly in the degree of disorganization of tissue to which they give rise; this variation depending partly upon the intensity of the heat that is applied, and partly upon its duration. The sudden and brief application of flame to the surface produces but very slight disorganization of the cuticle, with some inflammation of the skin. If the part be exposed for a longer time to the action of the flame, as when a woman's clothes take fire, the cutis itself may be disorganized, and, if the heat be still more intense, as when molten metal falls upon the body, the soft parts may be deeply charred, or the whole thickness of a limb destroyed. So, also, the effects of scalds vary greatly, not only according to the temperature of the liquid, but according to its character; the more oleaginous and thicker the fluid, the more severe usually will the scald be.

These various results of the application of heat to the surface have been arranged by Dupuytren into six different degrees of burn. In the 1st, there is merely a scorch of the skin, slight redness with efflorescence of the cuticle, but no permanent injury. In the 2d degree there is not only general redness of the part to which the heat has been applied, but vesicles form, either at once or in the course of a few hours, and sometimes attain a very considerable magnitude. In the 3d degree, the cutis itself is destroyed, yellowish-grey or brownish eschars forming, which involve the whole thickness of the skin, the surrounding integument being more or less reddened and vesicated, and the part extremely painful. If this amount of injury is the result of a scald, the eschars will be found to be soft, pulpy, and of an ashy-grey character. In the 4th degree, the whole thickness of the skin and part of the subcutaneous cellular tissue are destroyed, dry, yellowish-black, insensible eschars being formed, with considerable inflammation around them, leaving, on their separation, deep and luxuriantly granulating ulcerated surfaces. In the 5th degree, the eschars extend more deeply, implicating the muscles, fasciæ, and soft structures. And, in the 6th degree, the whole thickness of the limb is completely destroyed and charred. This is the celebrated classification introduced by Dupuytren, and adopted by most writers on the subject, as a practical exposition of the local effects of burns. These various degrees are usually found associated, to a greater or less extent; indeed, in the more severe forms, the three or four first degrees are almost invariably met with.

The primary *local effect*, then, of a burn, if superficial, is to excite inflammation of the skin; if more extensive, to destroy the vitality of more or less of the soft structures, and even the bones. When the cuticle is unbroken, the inflammation speedily subsides, with some desquamation. When the soft parts are charred, they are detached by a process of ulceration, analogous to what happens in the separation of sloughs, and an ulcerated and suppurating surface is left, remarkable for the large size, the florid color, the great vascularity, and the rapid growth of its granulations. The cicatrization of such an ulcer as this, though generally proceeding with great rapidity, has a constant tendency to be arrested by the exuberance of the granulations. The cicatrix that results is usually thin, and of a bluish-red color, and is especially characterized by a great disposition to contract, becoming, after a time, puckered up, and much indurated. This process of contraction and hardening, which begins immediately on the completion of cicatrization, continues for many months, giving rise frequently to the most serious deformities, and to the complete loss of motion and use in parts. These cicatrices are of a fibro-plastic and fatty character, and often extend deeply between, and mat together the muscles, vessels, and soft structures of a limb, of the face, or neck.

The *constitutional effects* resulting from burn are of the most serious and important character; they are dependent not so much upon the depth of the injury as upon its situation, the extent of surface implicated, and the age of the patient. Thus, a person may have his foot completely charred and burnt off by

a stream of melted iron running over it, with far less constitutional disturbance and danger than if the surface of the trunk and face be extensively scorched to the first and second degrees. Burns about the trunk, the head, and the face, being far more likely to be attended by serious constitutional mischief than similar injuries of the extremities. In children the system generally suffers more severely from burns than in adults. The constitutional disturbance induced by burns, in whatever degree, may be divided into three stages: 1st, that of depression and congestion; 2d, of reaction and inflammation; and, 3d, of exhaustion and suppuration.

1st. The *period of depression and congestion* occupies the first forty-eight hours, during which death may occur before inflammatory action can come on. Immediately on the receipt of a severe burn, the patient becomes cold, collapsed, and is seized with fits of shivering, which continue for a considerable time; he is evidently suffering from the shock of the injury; the severity of the shivering is usually indicative of the extent of the constitutional disturbance induced by the burn, and is more prolonged in those injuries that occupy a great extent of surface, than in those which, being of more limited superficial extent, affect the tissues deeply. On the subsidence of the symptoms of depression, there is usually a period of quiescence before reaction comes on, and during this period the patient, especially if a child, not unfrequently dies comatose; death resulting from congestion of the brain and its membranes, with, perhaps, serous effusion into the ventricles or the arachnoid. Besides these lesions, the mucous membrane of the stomach and intestines, as well as the substance of the lungs, are usually found congested.

The pathological phenomena of this period are altogether of a congestive character.

2nd. The *next period*, that of *reaction and inflammation*, extends from the second day to the second week. In it irritative fever sets in early, with a degree of severity proportionate to the previous depression, and as this stage advances special symptoms commonly occur dependent upon inflammatory affections, more especially of the abdominal and thoracic viscera. Death, which is more frequent during this stage than in the preceding one, is usually connected with some inflammatory condition of the gastro-intestinal mucous membrane, or of the peritoneum. The lungs also are frequently affected, showing marked evidence of pneumonia or bronchitis; but the cerebral lesions are not so common as in the first stage; though when they occur they present more unequivocal evidence of inflammatory action.

It is in this stage of burn, that that very remarkable and serious sequela, perforating ulcer of the duodenum, is especially apt to occur. Mr. Curling, who first attracted attention to it, explained its occurrence by the supposition that Brünner's glands endeavor by an increased action to compensate for the suppression of the exhalation of the skin, consequent upon the burn; and that the irritation thus induced, tends to their inflammation and ulceration. This ulceration may, as Mr. Curling remarks, by rapidly proceeding to perforation, expose the pancreas, open the branches of the hepatic artery, or, by making a communication with the serous cavity of the abdomen, produce peritonitis, and thus cause death. It usually comes on about the tenth day after the occurrence of the injury; seldom earlier than this. The only exception that I am acquainted with was in the case of a child nine years of age, who died on the fourth day after the burn, in University College Hospital, and in whom an ulcer, about the size of a shilling, with sharp cut margins, was found in the duodenum, the intestinal mucous membrane generally being inflamed. That these ulcers are not invariably fatal is evident from a case mentioned by Mr. Curling, in which, on death occurring eight weeks after the injury from other causes, a recent cicatrix was found in the duodenum. These affections seldom occasion any very marked symptoms to indicate the nature of the mischief, the patient suddenly sinking.

In some instances there is hemorrhage, though this is not an unequivocal sign, as I have several times seen it happen from simple inflammatory congestion of the intestinal mucous membrane; pain in the right hypochondriac region and perhaps vomiting may also occur.

3rd. The period of *exhaustion and suppuration*, continues from the second week to the close of the case. In it we frequently have symptoms of hectic, with much constitutional irritation from the long continuance of exhausting discharges. If death occur, it is most frequently induced by inflammation of the lungs or pleura; affections of the abdominal organs and brain being rare during this stage of the injury.

The influence of extent, degree, and situation, on the prognosis of burns has already been stated. The most fatal element indeed of these injuries is *superficial extent.* The cutaneous secretion being arrested over a large surface of the skin, congestion of the internal organs and of the mucous membrane must ensue; and hence death may happen directly from this cause, or from the supervention of inflammation in the already congested parts; more particularly in the early periods of life, when the balance of the circulation is readily disturbed. The *degree* of burn rather influences the prognosis unfavorably so far as the part itself is concerned, than as the general system is affected. The most fatal period in cases of burn is the first week after the accident. I find that in 50 cases of death from these accidents, 33 proved fatal before the eighth day; 27 of these dying before the fourth day. Of the remaining 17 cases, 8 died in the second week, 2 in the third, 2 in the fourth, 4 in the fifth, and 1 in the sixth.

The *treatment* of burns must have reference to the constitutional condition, as well as to the local injury. A vast variety of local applications have been recommended by different surgeons, such as flour, starch, cotton wadding, treacle, white paint, gum, solution of India rubber, &c.; the principle is, however, the same, viz., the protection of the burnt surface from the air. I shall here, however, content myself with describing the method that is usually followed with much success at the University College Hospital.

The *constitutional treatment* is of the utmost consequence. We have seen how death arises at various periods after these accidents from different causes, and we must modify our treatment accordingly. The first thing to be done after the infliction of a severe burn is to bring about reaction; the patient is trembling in a state of extreme depression, suffering great pain, and may sink from the shock unless properly supported. A full dose (about thirty minims for an adult) of the liquor opii should be given at once in some warm brandy and water, and repeated, if necessary, in the course of an hour or two; to a child the dose must be proportioned according to the age. The burnt clothes having been removed, the patient should be laid upon a blanket, and, whatever the degree of the burn, be well covered with the finest wheaten flour by means of an ordinary dredger. The flour should be laid on thickly, but uniformly and gradually, forming a soft and soothing application to the surface. If the cuticle have been abraded or vesicated, the flour will form a thick crust by admixture with the serum discharged from the broken surface. If the skin be charred, the discharge, which will be speedily set up around the eschar, will take the flour on to the part, forming as it were a coating impervious to the air. The crusts thus formed should not be disturbed until they become loosened by the influence of the discharges of the part, when they should be removed; and the ulcerated surface that is exposed, dressed with water-dressing, red wash or lead ointment, according to the amount of irritation existing, the suppurating sore indeed being managed on ordinary principles. In some cases lint dipped in the "*Carron oil*," composed of equal parts of linseed oil and lime water, to which a small quantity of spirits of turpentine might be added, has appeared to agree better than anything else, and in others cotton wadding answers admirably. Whatever local application be adopted, I hold it to be of the utmost importance in the early stages of the burn to change the dressing as seldom as possible; not until it

has been loosened, or rendered offensive by imbibition of the discharges. Every fresh dressing causes the patient very severe pain, and certainly retards materially the progress of the case.

When the stage of reaction has fairly set in, the patient's secretions should be kept free by the administration of an occasional mild purgative and salines. Should any inflammatory symptoms about the head, chest, or abdomen manifest themselves, it will be necessary to have recourse to antiphlogistic treatment proportionate to their severity. I have certainly seen patients saved under these circumstances by the employment of blood-letting and the proper application of leeches. At a later period in the case, when the strength has been exhausted by the continuance and the amount of the discharges, good diet, quinine, and a general tonic plan of treatment will be required, and any symptoms of hectic that supervene must be met in the ordinary way.

As cicatrization advances, much attention should be paid to repressing the exuberant granulations by the free use of the nitrate of silver, and the position of the part must be carefully attended to, so as to counteract, if possible, the after-contraction that ensues. With this view, the part must be properly fixed by means of bandages, splints, and mechanical contrivances, specially adapted to counteract the tendency to contraction of the cicatrix. This is especially necessary in burns about the neck, when there is a tendency for the chin to be drawn down on to the sternum, and great deformity to be thus occasioned; and in burns at the inside of limbs or the flexures of joints, when after-contraction is very apt to ensue. In such cases I have advantageously employed the elastic traction of India-rubber bands to counteract the tendency to contraction of the scar.

Operations for the removal of the effects of contraction, consequent upon burns, are occasionally required, and if judiciously planned and executed, may do much to remedy the patient's condition. The great obstacle to the success of these operations, however, consists in the fact that the granulations which spring from the contracted cicatrix are in their turn liable to take on the same contractile action as the original cicatrix. After the division of the cicatrix, also, it is often found that the subjacent structures have been so rigidly fixed in their abnormal position as not to admit of extension. It may then be necessary to divide some of these, as fasciæ and tendons, before that part can be restored to its normal shape.

These operations are most likely to be successful when they are practised for contractions at the flexures of the joints, as at the bend of the elbow, for instance. There, all that need to be done, is to divide the cicatrix down to the subjacent healthy structures, and then, by the proper application of splints or screw apparatus, gradually to extend the limb; if any muscles or tendons are found to offer resistance they may be divided, if this can be done without inflicting too serious a wound upon the part, and impairing its after-utility Much caution, however, will here be necessary; for if the contraction be of old standing, the arteries and nerves will likewise have become shortened, and will be incapable of stretching under any force that it may be safe to employ Operations that are undertaken for the removal of the disfigurements that occur about the face and neck as the result of burns, require much management. Instead of simple division of the cicatrix, it has been proposed to dissect it away entirely in some cases, in others, to transplant portions of healthy skin upon the surface thus denuded, or that results from the gaping of the wound during extension of the limb. In other instances, again, to divide it gradually by the pressure of a silver wire, passed through and twisted over it. In addition to the division of the cicatrix, Mr. James, of Exeter, and Mr. Quain, have in these cases very successfully employed a screw-collar, by which the chin can be loosed from the sternum, and gradual extension of the cicatrix effected.

Amputation may be required if the burn has destroyed the whole thickness of a limb; the part charred should then be removed at once, at the most convenient point above the seat of injury; so also amputation may be required at

a later period, if, on the separation of the eschars, it is found that a large joint has been opened, and is suppurating, or if the disorganization of the limb is so great as to exhaust the powers of the patient in the efforts at repair. Great caution, however, should be employed in determining on the propriety of amputating when the burn has extended, though in a minor degree, to other parts of the body, lest the powers of the patient be insufficient for the double call that will thus be made upon them.

FROST-BITE.

When the body has been exposed to severe or long-continued cold we find, as in the case of burns, that local and constitutional effects are produced. The *local influence* of cold is chiefly manifested on the extremities of the body, as the nose, ears, chin, hands, and feet, where the circulation is less active than at the more central parts. It chiefly occurs to an injurious degree in very young or aged persons, or in those whose constitutions have been depressed by want of the necessaries of life.

In the first degree of frost-bite that calls for the attention of the surgeon, there is a feeling of stiffness, with complete numbness of the part that has been exposed to cold; it looks pale, has a bluish tint, and is somewhat shrunk. In this state the vitality of the part is not destroyed, but is merely suspended. On the return of circulation and the vital actions in the affected part, a burning tingling pain is felt, it becomes red, and shows signs of a tendency to inflammatory action. Indeed, this appearance of inflammation, often accompanied by a burning sensation, is probably the immediate consequence of extreme degrees of cold, as is experienced on touching solidified carbonic acid or frozen mercury.

In the next degree of cold, the vitality of the part is completely destroyed; all sensibility and motion in it are lost, it becomes shrunken and livid; but though its vitality may have been annihilated by the immediate application of the cold, it is not until the part has become thawed that gangrene usually manifests itself; it then appears to do so by the violence of the reaction induced, the part rapidly assuming a black color, becoming dry, and separating eventually, as all other mortified parts do, by the formation of a line of ulceration around it.

The *constitutional effects* of a low temperature need not detain us. It is well known that after exposure to severe or long-continued cold, a feeling of heaviness and stupor comes on, which gradually creeps on to an irresistible tendency to sleep, which, if yielded to, terminates in coma, and a speedy, though probably painless, death.

The *treatment* of frost-bite consists in endeavoring to restore the vitality of the frozen parts. In doing this the great danger is, that reaction may run on to so great a degree as to induce sloughing of the structures whose vitality has already been seriously impaired. In order to prevent this accident occurring, the most gradual elevation of temperature must be had recourse to for restoring the part. The patient should be placed in a cold room, without a fire, any approach to which would certainly lead to the destruction of the frost-bitten members. These must then be gently rubbed with snow, or cold water, and held between the hands of the person manipulating; as reaction comes on, they may be enveloped in flannel or woollens, and a small quantity of some warm liquid or spirit and water administered to the patient. In this way sensibility and motion will gradually return, often with much burning and stinging pain, redness, and vesication of the part. If gangrene have come on, or if the reaction run into sloughing, the sphacelated part, if of small size, may be allowed to detach itself by the natural process of separation; if of greater magnitude, amputation of the injured limb may be required. This should be done at the most convenient situation for the operation so soon as the line of separation has fully formed.

DIVISION THIRD.

SURGICAL DISEASES.

CHAPTER XXIII.

ABSCESS.

An abscess signifies a collection of pus occurring in any of the tissues or internal cavities of the body. In structure, an abscess consists of an accumulation of pus situated in the midst of, and surrounded on all sides by a layer of fibrine deposited in and consolidating the neighboring tissues. This lymph, which constitutes the *wall* of the abscess, varies greatly in thickness and consistence, in some cases being scarcely perceptible, in others, some lines in thickness and of corresponding firmness, constituting, perhaps, the principal part of the mass. This wall of "limiting fibrine" is always very vascular, in consequence of the inflammation and congestion of the tissues that enter into its composition. Outside it there is an infiltration of sero-plastic matter, and beyond this again we reach the healthy tissue.

Surgeons divide abscesses into various kinds, according to the symptom attending them, their duration and cause. Thus they speak habitually of *acute* and *chronic*, *hot* and *cold*, *lymphatic*, *diffuse*, *metastatic*, and *puerperal* abscesses.

The *acute* or *phlegmonous* abscess may be taken as the type of the disease When it is about to form, the part which has been previously inflamed swells considerably, with a throbbing pulsatile pain; the skin becomes shining, glazed, and of a somewhat purplish-red. If the abscess be very deeply seated, the superimposed tissues become brawny and œdematous, without, perhaps, any other sign indicating the existence of pus. As the swelling approaches the surface it softens at one part, where fluctuation becomes perceptible, and a bulging of the skin covering its summit takes place; this *pointing of the abscess* indicates that it is about to burst, and discharge its contents, which it speedily will through a circular aperture formed in the skin. The pointing is an interesting pathological phenomenon, and takes place in the following way: — An abscess, originally formed perhaps deeply in the substance of a limb, enlarges by the extension of the periphery of its wall, and by the innermost layers of this structure at the same time degenerating into pus. As the wall extends, it has a special tendency to approach towards a free surface, whether that be external or internal, skin or mucous membrane; all the tissues between it and the surface towards which it is progressing being gradually absorbed or melting into the abscess. It is in this that *the pointing* essentially consists, and the mode in which it is finally accomplished would appear to be as follows: — the pressure that the tumor exercises from within outwards causes compression of those vessels, that, passing from the deeper parts, ramify between the summit of the abscess and the superjacent skin for its supply. In consequence of this pressure upon, and interference with, the

circulation through these vessels, the nutrition of the parts supplied by them is arrested, and they become softened, disintegrated in structure, and less resistant to the progress of the tumor than those tissues which surround it on other sides, and which have not had their vascular supply interfered with, or lost their normal cohesion. The abscess then naturally makes its way at this, the point of its circumference, where it meets with least resistance to its progress. As it approaches the surface, the skin at first becomes more or less livid, tense, and œdematous, conditions indicating the interference with its circulation; as the summit of the abscess presses upwards, the overlying skin loses its tension, and becomes relaxed; it then sloughs at the most central point, from which the cuticle has previously peeled off, and the outward pressure of the pus speedily detaching the slough, the abscess discharges itself. Though acute abscesses, if left to themselves, usually run this course and burst through the skin, the mucous or serous surfaces, or even into the interior of joints, yet some collections of pus, if very deeply seated, cannot find their way to the surface, but extend through the cellular planes of the limb in a lateral direction, burrowing and undermining parts to a great extent; or if situated in dense and unyielding structures, as in bone, are imprisoned within a case through which they may be unable to penetrate; in other rare instances, the abscess disappears by the pus becoming absorbed. After an abscess has burst, the cavity usually closes by granulations springing up from within, and by the collapse of its walls; in some cases, however, it does not completely close, but contracts into a narrow canal, forming a sinus or fistula.

Chronic abscesses are of very common occurrence, a piece of dead bone having given rise to irritation in its vicinity, or a gland, or some portion of the subcutaneous cellular tissue having become indurated, tender, or subacutely inflamed, at last slowly and without any constitutional symptoms, or much appearance of local disturbance except the swelling, softens and breaks down into a somewhat thin, flaky, curdy, puriform fluid, though in other instances the pus is perfectly healthy. These abscesses do not readily point, but often extend laterally, burrowing for a considerable distance from their original seat. In other cases they become circumscribed by a thick and dense wall of fibrine, through which it may be extremely difficult, and perhaps impossible, to detect fluctuation, the disease then simulating a solid tumor. The duration of these chronic abscesses without opening, is often very remarkable, even when situated in soft parts. I have seen large chronic abscesses in the iliac fossa and groin, perfectly stationary for nearly two years. When situated in denser structures, as in the substance of the breast for instance, the wall may become so dense as to resemble a cyst, and the disease will continue in the same state for a great length of time. In the bones, abscesses may exist for an indefinite period.

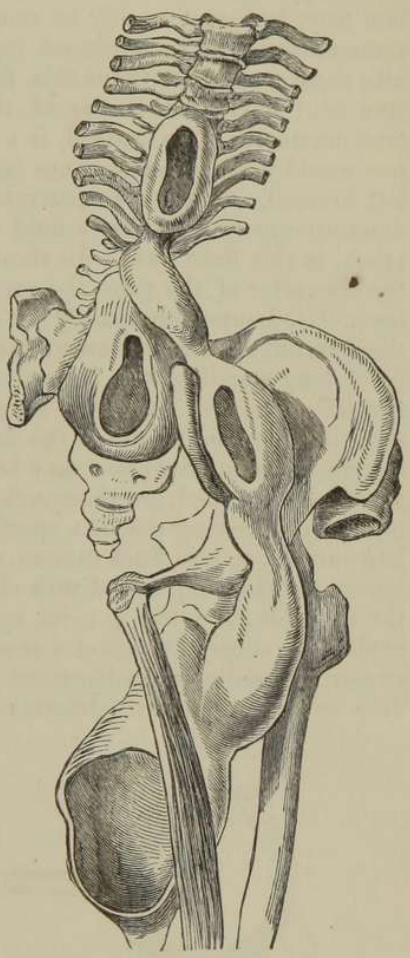
The *cold, lymphatic* or *congestive* abscess occurs not unfrequently with but very slight precursory local symptoms, and indeed not uncommonly without any at all. The patient, who has usually been cachectic, and suffering some time from general debility, after feeling slight uneasiness in the groin, iliac fossa, or axilla, finds suddenly a large fluctuating tumor in one or other of these situations; there is perhaps no pain in the part, and no discoloration of the skin, but the fluctuation is always very distinct, the limiting fibrine being in small quantity. On opening such an abscess as this, there will usually be a copious discharge of thin unhealthy pus, which when examined under the microscope will be found to contain ill-developed, withered cells; in some cases the contents appear to be a clear semi-transparent or oily-looking matter, probably seroplastic effusion.

Diffuse abscess forms rapidly in the cellular tissue, as the result of diffuse inflammation of it. In these cases there is no limiting fibrine, and hence the pus often spreads widely, producing extensive destruction of parts before it is discovered. A particular variety of this form of abscess is the *puerperal*, occur-

ring in women after parturition, in various parts of the body, especially in the iliac fossa, the cellular planes of the thigh or in the joints, and in the adipose tissue of the orbit, often destroying the globe of the eye. To these forms of the disease the *metastatic* abscesses are closely allied. They commonly occur in connection with phlebitis and pyemia, are very numerous, and are met with in the substance of organs as well as the cellular tissue and joints. The three last species of abscess are varieties of the acute form.

The *tympanitic or emphysematous abscess*, which contains gas as well as pus, is occasionally met with in the neighborhood of the mucous canals, chiefly at the anterior and lateral parts of the abdominal walls and about the sacrum. Sometimes the communication with the intestine is very free, in other cases it is not so evident. These collections are often perfectly resonant on percussion, the air being above, the fluid below, and sometimes gurgling, is very distinct in them.

Fig. 135.



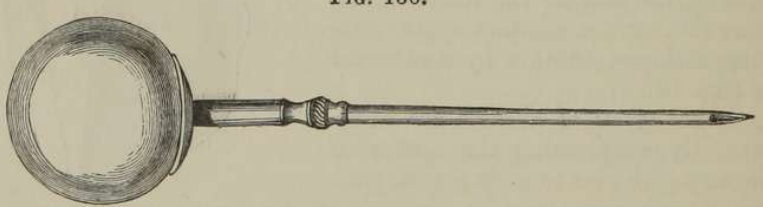
Abscesses are met with in all regions of the body, but more especially in the cellular tissue; particularly in those parts where this tissue is abundant, and the absorbent glands are numerous. They may occur at any period of life, from the earliest infancy to old age. I have opened a very large abscess in the axilla of a child about a fortnight old. Their size varies from that of a pin's point to a tumor containing a pint or more of pus. In some cases when very large they are multilocular, the different cysts being connected by narrow channels of communication; in this way I have seen a large abscess extending from the lumbar vertebræ through the iliac fossa down the thigh, the ham, and the leg, until at last it was opened by the side of the tendo Achillis, forming five or six distinct cysts, communicating with one another by contracted channels (fig. 135).

The *pressure-effects* of abscess are often important. By compressing the nerves of a part it may give rise to very severe pain and spasm at a distance from its seat, and in this way in some apparently neuralgic affections it has turned out that the pain has been occasioned by the pressure of an abscess on the trunk of a neighboring nerve. When blood-vessels come into relation with an abscess, they usually become coated by a thick layer of lymph, which guards them from injury. In some cases, however, they become obliterated by the conjoined effects of the pressure and the inflammation, in which they partake as well as the adjacent tissues. In other cases, more particularly in strumous and cachectic individuals, the blood-vessels not having been guarded by the protecting lymph, have ulcerated and burst into the cyst of the abscess, occasioning sudden, dangerous, or even fatal hemorrhage. It is seldom, however, that a large artery or veins pours its contents into an abscess that had not been opened. The various mucous canals, more especially the trachea and the urethra, may be injuriously compressed by neighboring ab-

scesses; so also bones may become necrosed, and joints inflamed and destroyed, from the same cause.

The *diagnosis* of abscess, though usually easily made, at times requires attention. The surgeon believes that an acute abscess is about to form when, after rigors and some modification of the inflammatory fever, he finds the local signs characteristic of the formation of pus; more especially a throbbing pain in the part, with softening of any induration that may have existed, and œdema of the cellular tissue covering it. His suspicion is turned to certainty, and he knows that an abscess has formed, when, after the occurrence of these symptoms, fluctuation can be felt, and the other signs manifest themselves. This fluctuation may, however, readily be confounded with the undulatory sensation that is communicated by some tissues from the mere infiltration of sero-plastic fluid into them, or even without this, from their natural laxity, as is sometimes the case in the cellular tissues of the nates and thigh in persons of lymphatic temperament. This, indeed, is a difference of degree rather than of kind, as pus would make its appearance in the course of a few hours, if the tumor were left to itself. The mere occurrence of fluctuation is not of itself sufficient to determine more than that a fluid exists in the part. The question necessarily arises, is this fluid pus? In the majority of instances the history of the case, the character of the pain, the previous existence and the continuance of symptoms of inflammation, enable the surgeon to answer in the affirmative. But if there be but obscure evidence of inflammation having existed, and if the swelling be of long standing, the fluctuation being perhaps deeply seated and indistinct, the safer plan will be for the surgeon to introduce an exploring needle, and to see what the true nature of the fluid is; by this simple means many embarrassing mistakes in diagnosis may be avoided. The tumors with which abscesses may be confounded, are those soft solid growths in which there is a high degree of elasticity, giving rise to a species of undulation, as in some kinds of encephaloid tumor; so also fluid tumors of various kinds, such as cysts and enlarged bursæ, may be confounded with abscess. In these cases the previous symptoms, the situation, and the general appearance and feel of the tumor, will usually enable the surgeon to effect a ready diagnosis; but should any doubt exist, the exploring needle or trochar must be introduced, when the escape or not, of a drop or two of pus will determine the question. Coxeter's "suction trochar"

Fig. 136.



(fig. 136), is of especial service in cases in which it is desirable to withdraw some of the contained fluid for closer examination. The diagnosis of an abscess having pulsation communicated to it by a subjacent artery, from an aneurism, will be discussed when we come to speak of that disease. It may be well to mention that the pains occasioned by the pressure of some forms of chronic abscess upon neighboring nerves have been mistaken for rheumatism.

Abscesses vary greatly in danger, according to their nature, size, situation, &c. The chronic form is usually attended by more risk than the acute and the diffuse. The puerperal and pyemic are especially hazardous to life, being generally associated with a bad state of the blood. The large size of some abscesses is an element of great risk, occasioning not only a very abundant discharge of pus, but likewise great constitutional irritation when opened. Abscesses that are situated in the neighborhood of important organs, as about the neck of the

bladder, or in the anterior mediastinum, are necessarily much more hazardous from the peculiarity of their situation than those which are met with in less important regions. The cause of the abscess also influences the result; if it be a piece of dead bone that can be removed, the discharge will speedily cease on its being taken away, but if it be so situated that it cannot be got rid of, it will, by acting as a continuous source of irritation, keep up a discharge that may eventually prove fatal. The constitution of the patient influences our prognosis. Such an amount of discharge as would inevitably prove fatal in a cachectic system, may influence a sound one but very little; so also, the wasting effect of the abscess is better borne about the middle than at either of the extreme periods of life.

The *treatment* of abscess presents three points requiring attention. The first object should be to prevent the formation of matter; the next, to take steps for its evacuation when formed; and, lastly, to endeavor to close the cavity that results.

In order to prevent the formation of matter, it is necessary to get rid of any local irritant that may exist; thus dead bone should be removed, or extravasated urine let out of the cellular tissue. After this has been done, the preventive treatment must consist in the active employment of local antiphlogistic means, such as leeches and cold evaporating lotions: any slight tenderness that continues after the inflammation has subsided must be removed, and that swelling from exudation matter, which is especially the precursor of chronic abscess, must be got rid of by the continuous application of some discutient lotion. One composed of iodide of potass, ʒ i., spirits of wine, ℥ i., water, ℥ vij., is extremely useful; in some cases absorption may advantageously be promoted by mercurial ointments or plasters. When once pus has formed, it is a question whether it can be absorbed again; in general, it certainly cannot, more especially if once a distinct cyst has formed around it; but in some cases it may undergo absorption; thus, in hypopium, we occasionally observe that the pus deposited in the anterior chamber of the eye is removed, and I think it probable that the same may happen when it is infiltrated into the tissues of a part, without a very distinct wall surrounding it. The more fluid parts of chronic abscesses occasionally become absorbed, leaving a cheesy residue behind, which may degenerate into cutaceous matter.

When, notwithstanding the employment of antiphlogistic means, it is evident that pus is about to form, the treatment should be completely changed, and by the aid of warmth and poultices, an endeavor should be made to hasten suppuration. When this is fully established, the abscess having become "ripe," steps must be taken for the evacuation of the matter. The treatment of acute and of chronic abscesses differs essentially in this respect.

In the *acute* abscess the matter should be let out as soon as it is fully formed, especially in those varieties of the disease connected with a morbid state of the system, as in the metastatic and puerperal forms. When this is done, the constitution at once experiences great relief, the fever and general irritation subsiding materially; the free incision by which this is accomplished not only letting out the pus and lymph, but removing tension, and by encouraging local bleeding, lessening the inflammatory action. The rule of opening an acute abscess early is especially imperative when the pus is formed in the sheaths of the tendons and under fibrous expansions, as in the palm of the hand; so, also, when it is situated deeply in the cellular planes of a limb, under the larger muscles, where it has a tendency to diffuse itself extensively. In those cases likewise in which it is lodged in close proximity to a joint, or under the periosteum, it must be let out early; so also when it presses upon mucous canals or important organs, as on the urethra or trachea, or when it is dependent on the infiltration of an irritant fluid into a part, as by urinary extravasation, it must be evacuated without delay. The pus should always be let out early before the

skin covering it is thinned, when the abscess is situated in the neck or in any other part where it is desirable that there should be as little scarring as possible.

In the case of *chronic* abscesses, the rule of surgery is not so explicit. Here the collection is often large, coming on without any very evident symptoms, and giving rise to no material inconvenience; but if it be opened, putrefaction of the pus, consequent upon the entry of air into the extensive cyst, will give rise to the most serious constitutional disturbance, setting up irritative fever that may rapidly prove fatal in a debilitated frame, and should the patient escape this danger, the drain of an abundant suppuration may speedily waste him. Hence, it not uncommonly happens that a patient may carry a chronic abscess unopened, without any very serious disturbance, for many months or even years, but when once opened, that he will die in a few days. If, however, the chronic abscess be so small that no danger is to be apprehended from the inflammation of its cyst, or if it be situated in parts where its presence may give rise to dangerous pressure, the matter should be let out without delay.

There are three modes by which abscesses may be opened, each of which possesses advantages in particular cases: — these are by *incision*, by *tapping* with a trochar, and by making an aperture into the cyst with *caustic*.

Incision is the only plan that should be practised in acute abscesses. For this purpose a lancet, an abscess-bistoury (fig. 137), or a sickle-shaped knife may be used. The incision should be made either at the point where fluctuation is most distinct, or at the most dependent part of the tumor, so as to prevent after-bagging of the matter. It should be made by holding the bistoury or

Fig. 137.

lancet short, and introducing it perpendicularly into the softened part. If the depth to be reached is considerable, a bistoury should be used, the blade of which should be half turned round after its introduction, when the pus wells up by its side, the point being felt to move freely in the cavity of the abscess. The incision must then be continued for a moderate extent in the direction of the natural folds of the skin of the part, or in the course of the vessels. The pus should be let out freely, so as to allow the walls of the abscess to collapse, but it should not be forced out by squeezing the sac. It may happen, after the escape of the pus, that the cavity of the abscess fills with blood by the rupture of some small vessel situated in its wall; this, however, is of little moment, the hemorrhage speedily ceasing on the application of pressure, of a bandage, or of cold. After the opening has been made, a poultice or water-dressing must be applied; the cavity left, eventually fills up either by the coalescence of its sides, or by granulating from below; if it fill again with pus, a fresh incision, termed a "counter-opening," must be made in the most dependent part.

In the treatment of chronic and cold abscess, all three plans may be employed for opening the sac. If it be of small size, an incision should be made into it at once. If the collection be considerable, we must wait until an opening has been rendered necessary by the tendency to implication of the skin, or by injurious pressure being exercised on important parts; the pus should then be let out by the valvular aperture recommended by Abernethy, the object being to limit the entry of air into the interior of the abscess, to lessen the chance of putrefaction of any pus that is left, and of consecutive inflammation of the cyst. The valvular opening is made by drawing the skin covering the abscess well to one side, then passing the bistoury directly into the sac, and allowing as much

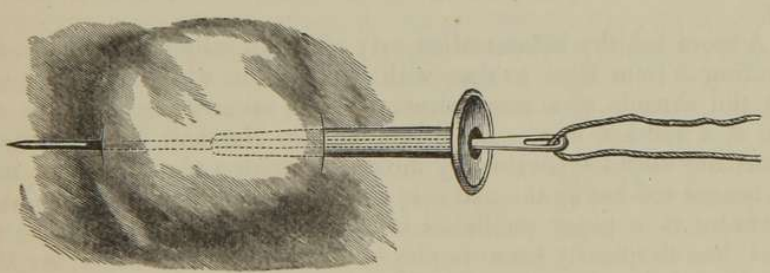
of the pus to escape as will flow out by the collapse of the walls of the abscess; before the matter has quite ceased to flow, and before any air can consequently have got into the sac, the skin should be allowed to recover its natural position, so that the aperture in it and in the cyst may no longer directly communicate. A piece of plaster, or of lint soaked in collodion, should be placed upon the external wound, which will probably heal under this covering in the course of a short time. When the cyst of the abscess has again filled somewhat, this process may be repeated; and less and less pus being allowed to accumulate in it before each succeeding evacuation, it may gradually contract and close.

Instead of making the valvular opening in this way, a chronic abscess may sometimes be advantageously opened by tapping with a trochar and canula of moderate size, the instrument being introduced obliquely between the skin and the abscess, and then made to dip down into the sac. After the withdrawal of the canula, the aperture may be closed as in the former case. There is, however, one disadvantage in this plan of opening abscesses; that if the discharge be curdy or shreddy, it is very apt to block up the canula, and thus to interfere with the proper evacuation of the matter.

The potassa fusa, though a painful application, may be advantageously used for opening those chronic abscesses, the skin covering which is much undermined, congested, and discolored. In these cases I commonly employ it with great advantage. It is also useful in the after-treatment, when much solid plastic matter is left, by dissolving this away, and thus preventing the formation of sinuses.

In some forms of abscess it will be found that those processes which are necessary for the contraction and closure of the cyst, after its contents have been evacuated, do not readily take place; and it becomes necessary to have recourse to other measures, in order to excite sufficient healthy inflammatory action, to occasion the deposition of that plastic matter by which the cavity is filled. With this view, a seton of two or three threads may very usefully be passed across the cyst by means of a nævus needle, or by a long straight needle pushed up through the canula used for tapping (fig. 138). It should be left in for a few days, by which time healthy inflammation will be set up. In other cases again, after the cyst has been tapped, the red wash or some tincture of

Fig. 138.



iodine should be injected and left in. These methods of exciting inflammation are especially useful when the cyst is thin, and of a very chronic character. When the walls are very thick and dense, as sometimes happens in abscesses of very old standing situated in the neck, an elliptical piece of the anterior portion of the cyst should be dissected out, and the remainder of the cavity, lightly dressed with lint, be allowed to fill by granulation. This plan of treatment is often very successful, and I have in this way cured abscesses in the neck of seven or eight years' standing, which have resisted every other plan employed.

The constitutional treatment of abscess must be conducted on the general principles laid down in discussing the management of suppurative inflammation

(p. 97); but it must be borne in mind, that as abscess is always a disease of debility, a tonic and stimulant plan will early be required.

SINUS AND FISTULA.

After an abscess has been opened, its cavity may not fill up completely, but contracting into a narrow suppurating track, forms a canal without disposition to close, and from which a small quantity of pus constantly exudes, thus constituting a *sinus* or *fistula*.

The cause of this non-closure of the cyst of an abscess may be referred to the following heads: — 1st. The presence of a foreign body, as of a piece of dead bone at the bottom, may keep the track open; 2d. The passage of irritating secretions, as of urine, fæces, saliva, &c., through the abscess, will prevent its complete closure; and 3d. The contraction of neighboring muscles will occasionally prevent the due coalescence of the sides of the abscess; as when it is in the neighborhood of the sphincter ani, and as may occasionally happen in abscesses about the limbs.

A sinus or fistula consists of a narrow channel, often long and winding, having an external orifice that is usually somewhat protuberant, being situated under or in the midst of loose florid granulations. The walls of this channel, which are always indurated, are lined by a structure resembling mucous membrane; this, however, it is not, but simply consists of a layer of imperfectly-formed granulations, exuding ichorous pus. If the orifice be occluded, this pus will collect within the sinus, and distending its walls, reconvert it into an abscess. In structure, therefore, a sinus or fistula may be said to be a long, narrow, chronic abscess, with a permanent external aperture.

The *treatment* of a sinus or fistula has reference to its cause in the first instance; for until the foreign body that keeps it open and maintains the discharge is removed, it will be useless to attempt its closure. After its removal, we may endeavor to procure obliteration of the sinus by one of three methods.

1st. The employment of pressure, by means of a roller and graduated compresses, so as to cause an agglutination of its opposite sides. This plan is useful in those cases in which the sinus is recent, without much surrounding induration, and so situated, as upon the trunk, that pressure can easily be applied.

2d. A more healthy inflammation may often usefully be excited in the sinus, by injecting it from time to time with red wash, or with tincture of iodine, by passing the threads of a seton through it, or stimulating it by the occasional contact of a red-hot iron. My colleague, Mr. Marshall, has invented a very ingenious and useful apparatus, by means of which a platinum wire, introduced cold, is heated red-hot by the galvanic current. This plan of treatment, which is fully detailed in a paper published in the "Medico-Chirurgical Transactions" for 1851, has frequently been employed with much success in the University College Hospital in the treatment of fistulæ and sinuses to which other methods were not very applicable.

3d. The last method consists in laying open the sinus from end to end, and then dressing the wound so that it may heal from the bottom; in this way neighboring muscles, that have kept it open by their contractions, may also be set at rest. The division of the sinus should be done with a probe-pointed bistoury, introduced through the external opening either by the aid of a director or without such assistance. The operation should be done effectually, the sinuses being usually followed as far as it is prudent to go, and laid completely open.

CHAPTER XXIV.

ULCERS.

Various forms of ulcer, affecting the cutaneous surface or mucous membranes, are familiar to the practical surgeon. When occurring in the skin, as the result of non-specific disease, they may be arranged under the following heads: the *Healthy*—the *Weak*—the *Indolent*—the *Irritable*—the *Inflamed*—the *Phagedænic* or *Sloughing*—the *Varicose*—and the *Hemorrhagic*. Besides these varieties, each of which is marked by distinct characteristics, various other forms of ulceration depending on specific causes, as the syphilitic, scrofulous, lupoid, cancerous, &c., are met with, all of which will be treated under their respective chapters.

The varieties presented by ulcers are by no means dependent on local conditions merely, though these influence them greatly, but are in a great measure owing to constitutional causes. Indeed, the aspect of an ulcer, the character of its granulations and of its discharge, are excellent indications of the state of health and of the general condition of the patient, as well as of the local disease that exists.

Ulcers may be situated upon any part of the cutaneous surface as the result of violence; most commonly when occurring from disease of a non-specific character, they are seated on the leg, but when arising from some specific affection they occur in particular situations, as on the penis, lips, &c.

The *healthy* or purulent ulcer may be considered the type of the disease, presenting a circular or oval surface, slightly depressed, thickly studded with small granulations exuding laudable pus, and having a natural tendency to contract and heal. It is the object of all our treatment to bring the other forms of ulcer into this condition. In the management of this healthy ulcer, the treatment should be as simple as possible, water-dressing and the pressure of a bandage usually enabling it readily to cicatrise.

The *weak* ulcer not uncommonly occurs from emollient applications having been continued for too long a time to the last variety of the disease, the granulations then becoming high and flabby, with a semi-transparent appearance about them, and sometimes rising in large, exuberant, gelatinous, reddish-looking masses above the surface of the sore. These high granulations have a feeble vitality, and readily slough. The treatment of this form of ulcer consists in keeping the part elevated and carefully bandaged, with an astringent dressing to the sore; such as a weak solution of the sulphate of zinc or of copper, or the "red wash," according to the following formula: — Sulphate of zinc, grs. xvj.; comp. tinct. of lavender and spirits of rosemary, of each ʒij.; water ℥viij., will be found a most useful application, in addition to touching the granulations from time to time with the nitrate of silver.

The *indolent* ulcer is always of a very chronic character; it is situated upon the outer side of the lower extremities, between the ankle and calf, and most frequently occurs in men about the middle period in life. It is deep and excavated, with a flat surface, covered by irregular and badly-formed granulations, exuding a thin and sanious pus, having hard, elevated, and callous edges, and presenting generally an irregular and rugged look. The surrounding integument is congested and matted to the subjacent parts; there is usually very little subcutaneous cellular tissue about it, the skin being firmly fixed to the subjacent fascia; and it would appear as if it were in consequence of this want of a vascular substratum from which to spring, that granulations do not readily arise. There is no pain attending this ulcer, and its surface, which often attains a very large size, may usually be touched without the patient feeling it. The principle of

the treatment here is two-fold, to depress the edge, and to elevate the base of the sore. This is effected by pressure and stimulation conjoined. The treatment should be commenced by rubbing the surface of the ulcer and the surrounding congested integument with nitrate of silver; a linseed-meal poultice should then be applied for twenty-four hours, after which the sore should be properly strapped on the plan recommended by Baynton. The best plaster for this purpose is the *emplastrum saponis*, to which some of the *empl. resinæ* is added to make it sufficiently adhesive; this, spread upon calico, should be cut into strips sixteen or eighteen inches in length and about an inch and a-half in width; the centre of the strip should then be laid smoothly on the side of the limb opposite to the sore, and its ends being brought forward, are to be crossed obliquely over it. Strip after strip must be applied in this way until the limb is covered for a distance of a couple of inches above and below the ulcer. If the sore be near the ankle, this joint should be included in the strapping. Each strip of plaster should be applied with an equal degree of pressure, which may often be considerable, and should cover at least one-third of the preceding strap; the limb must then be carefully bandaged from the toes to the knee. Under this plan of treatment, the edges will subside, the surface of the sore become florid, and granulation, yielding abundant discharge, speedily spring up. Much of its success will depend upon the close attention that is paid to the case; if the skin be irritable, no resin-plaster should be used, but merely the soap or lead, and the plasters should be changed at least every forty-eight hours. If the discharge be very abundant, small holes should be cut in the strips to allow it to escape. When by this plan of treatment the edges of the sore have been brought down, and the granulations sufficiently stimulated, an astringent lotion with bandaging may advantageously be substituted for the plasters. In some of these cases I have found benefit from the internal administration of liquor arsenicalis.

The *irritable* ulcer is mostly met with in women about the middle period of life, more especially in those of a nervous and bilious temperament. It i usually of small size, and situated about the ankles, or upon the shin. Its edges are irregular, but not elevated, the surface greyish, covered with a thin slough, and secreting unhealthy sanious pus. Its principal characteristic is the excessive pain accompanying it, which often, by preventing sleep, disturbs seriously the general health. In the treatment of this ulcer we must attend to the constitutional as well as the local condition. The patient should be put upon an alterative course of medicine, with aloëtic purgatives and some sedative at bed-time to procure rest. The mode of topical medication that I have found to succeed best is to brush the surface of the sore and the surrounding parts from time to time with a strong solution of the nitrate of silver, and then to keep emollient and sedative applications to it, such as lead and opium lotions. The occasional application of the nitrate of silver deadens materially the sensibility of the sore and assists its granulation.

The *inflamed* ulcer is characterized by much redness, heat, and swelling of the surrounding parts, with a thick and offensive discharge, often streaked with blood; it may come on from the over-stimulation of one of the other varieties. The treatment must be locally and generally antiphlogistic. The elevated position, the application of leeches around the sore, and of cold evaporating lotions to the surface of the limb, will speedily subdue the inflammatory action, after which, the healing process takes place with great rapidity.

The *sloughing* ulcer, when not specific, is an increased degree of the inflamed variety, usually occurring in a feeble or cachectic constitution, and generally accompanied by a good deal of fever of the irritative type. An angry dusky red blush forms about the sore, which becomes hot and painful; the surface assumes a greyish sloughy look, the edges are sharp cut, and the ulcerative action extends rapidly. The treatment in these cases should consist

in improving the general health by lessening irritation, and keeping up tone. The administration of opiates with nourishing but unstimulating diet, should be trusted to at the same time that the local action is subdued by rest and warm opiate lotions. When the inflammatory condition has subsided, tonics should be given internally, and a grain or two of the sulphate of copper or of zinc may be added to the lotion with which the sore is dressed. The specific varieties of sloughing ulcer will be considered in the chapter on Hospital gangrene, &c.

The *varicose* ulcer derives its chief characteristic from being complicated with, or dependent upon, a varicose condition of the veins of the leg. In this affection of the venous trunks the skin gradually undergoes degeneration, becoming brawny, of a purplish brown color, and being traversed in all directions by enlarged and tortuous cutaneous veins. The ulcer forms at one of these congested spots, by the breaking down of the already disorganized and softened tissue, forming a small irregular chasm of an unhealthy appearance, and varying much in character, being sometimes inflamed, at others irritable or sloughy, and then becoming indolent. One of the most serious effects of this ulcer is, that by penetrating into one of the dilated veins it occasionally gives rise to very abundant hemorrhage, the patient, in the course of a few seconds, losing a pint or two of blood. This hemorrhage may be readily arrested by laying the patient on his back, elevating the limb, and compressing the bleeding point with a pledget of lint and a roller. The treatment of a varicose ulcer must have special reference to the condition of the veins that occasions it; no local applications having much effect unless the pressure of the column of blood in the dilated vessels be taken off the part. This may be done by means of a well-applied bandage, made of elastic material, or a laced or elastic stocking applied to the leg, so as to keep up a uniform pressure upon the distended vessels. In some cases, the length of the column of blood may be broken by the application of a vulcanized india-rubber band below the knee. In many cases the cicatrizations of the ulcer cannot be brought about in this way, or, if it heal, it will constantly break open again; or hemorrhage may have occurred from a ruptured vein upon its surface: means must then be taken for the permanent occlusion of the varicose vessels by their ligature, as will be described in the chapter on those affections. As this procedure, however, is attended by some danger from the occasional induction of phlebitis or erysipelas, it should not be had recourse to unless the existence of one or other of the conditions just mentioned urgently calls for it.

The *hemorrhagic ulcer* is a dark, purplish-looking sore, occurring in women suffering from amenorrhœa, and having a special tendency, whence its name, to ooze blood about the menstrual periods; it usually partakes of the character of the irritable ulcer, and requires to be treated by constitutional means, having for their object the improvement of the patient's general health; with this view the preparations of iron and aloes are especially useful.

Various forms of ulcer occur upon the mucous membrane of the throat, rectum, and genital organs. As these, however, are commonly of a specific character, they will be hereafter described. When ulcers of the mucous membrane are not of a specific character, they present the general appearances characteristic of the cutaneous, healthy, inflamed, or weak varieties, and require the topical applications suited to these conditions; though generally they will bear and require the free employment of caustics, especially of the nitrate of silver.

CHAPTER XXV.

MORTIFICATION, OR GANGRENE.

THE local death of a part of the body, in surgical language, is termed *Mortification* or *Gangrene:* when the morbid action is confined to the osseous structures or to the cartilages, it is termed *Necrosis;* when limited to the soft tissues of a limb, *Sphacelus;* and when accompanied by ulceration, it is called *Slough.* Many other varieties of gangrene are recognized by surgeons; like all other diseases, it may be *acute* or *chronic* in its duration; as the parts affected are moist and swollen or dry and shrivelled, it may be divided into the *moist* and the *dry* or *mummified* gangrene; so, again, according to its cause, it is spoken of as *idiopathic* or *traumatic,* and very frequently and most correctly, perhaps, arranged under the denominations of *constitutional* and *local,* without reference to the comparatively accidental circumstances of its dryness or moisture. Besides these, various *specific* forms of the disease are met with, which will require special consideration.

Whatever form the gangrene may assume, there are certain local phenomena that are common to all the varieties of it. There is complete loss of sensibility and of motion in the part affected, the temperature of which falls considerably below that of the body generally, giving rise to a sensation of damp and clammy coldness, and after a time there is an odor of putrescence evolved, with very commonly an emphysematous crackling from effusion of gas into the tissues of the part. The color of the part affected is usually of a dark purplish or greenish-black, more or less mottled with red. This, which is unlike anything else in the system, shows that changes of importance have taken place in the solids and fluids of the diseased tissues, and is usually connected with the moist and swollen form of the disease. In the dry variety of gangrene, the color is often at first of a pale tallowy-white, with a mottled appearance upon the surface. The skin soon shrivels, becomes dry, horny, and semi-transparent, and eventually assumes a brown, wrinkled appearance; in other cases, again, the gangrened part is brown, dry, and shrivelled from the very first. These differences in the color of the mortified part indicate corresponding differences in the cause of the affection. In general terms, it may be stated that the dark varieties of gangrene are the result of destructive changes taking place in the very part itself, or are of constitutional origin, whilst the pale form of the affection occurs as a consequence of some obstruction in the supply of blood to the part, and is a local disease only, influencing the constitution secondarily.

The processes adopted by nature for the arrest of gangrene, by the formation of a *line of demarcation,* and for the detachment of the parts that have lost their vitality, by the extension of ulceration along the *line of separation,* have already been fully described (pp. 103, 104).

The *constitutional symptoms* vary greatly: when the disease is strictly local, affecting a part of but limited extent, and of no great importance, perhaps, to the economy, they are not very strongly marked. If, however, the gangrene, although limited, implicate organs of importance to the system, as a knuckle of intestine, for example, marked symptoms declare themselves. Whatever the precursory condition may be, the full invasion of the gangrene, if it be of rapid occurrence, is always accompanied by constitutional disturbance of an asthenic type, attended by great depression of the powers of the system, with a dull and anxious countenance, and a feeble, quick, and easily compressible pulse; the tongue is brown, and soon becomes loaded with sordes. When the

gangrene is internal, a sudden cessation of pain, with hiccup, vomiting, and tympanitic distension of the abdomen, may be superadded to the symptoms, and indicate the mischief that has occurred. Death usually supervenes with low delirium, twitchings, and coma. When the invasion of the gangrene is more gradual, as we see in some of the constitutional forms affecting the lower extremities, the symptoms are usually those of irritative fever, eventually subsiding into the asthenic form.

The *diagnosis* of gangrene is easily effected when this condition has fully developed itself; but in the early stages, before it is positively declared, it is not always an easy matter to determine its existence. The ecchymosis and discoloration of a bruise, the collapse and lividity that result from cold, or the dark purple hue occasioned by long-continued congestion, may readily be confounded with impending gangrene. In these cases of doubt, the surgeon should not be in too great a hurry to pronounce an unfavorable opinion, and still less to act upon it, for it not uncommonly happens that parts of the body that had to all appearance lost their vitality, may by proper treatment regain it.

The *prognosis* of gangrene is always bad, so far as the part itself is concerned, though it occasionally happens that when it is not fully established, partial recovery may unexpectedly take place. So far as the life of the patient is at stake, much will depend on the cause of the affection, and the age and strength of the individual in whom it occurs. At advanced periods of life, and in a feeble state of system, the result is always unfavorable; so also whilst the gangrene is spreading, the prognosis is bad, as it is impossible to say where the morbid action may stop; but when once the line of demarcation has formed, indicating as this does the possession of a certain vigor of constitution, the principal danger is over, and then the result will depend on the power of the patient, and the support that can be given during the processes of separation and of repair.

The *causes* of gangrene are very various. They may be arranged under four principal heads:

1st. The *intensity or specific nature of the inflammation* of a part may give rise to its death by the stagnation of the blood within its vessels, or by inducing such changes in it as are incompatible with life.

2d. The *arrest of the circulation* through a part is a common cause of gangrene, and may be occasioned in one of three ways; either by strangulation of the part generally; by the obstruction of the flow of blood through the main arteries leading to it; or, by the return of blood through the principal veins coming from it being interfered with.

3d. *Traumatic causes* of various kinds give rise to different forms of gangrene, most of which we have already considered. Thus the severe contusion, compression, or laceration of a part may occasion gangrene of it (page 116); the infiltration of an irritating fluid into a part; and, lastly, its exposure to intense heat or cold will destroy the vitality of the tissues implicated.

4th. *Specific poisons* of various kinds occasion special diseases, of which gangrene is the principal characteristic. Thus hospital gangrene, malignant pustule, noma, carbuncle, and ergotism, are instances of specific affections, accompanied by gangrenous action.

Amongst the causes, some are *constitutional*, others *local*, in their action: — those forms of gangrene are said to be *constitutional* which arise from intense or specific inflammation of the part—from obstruction of the circulation in consequence of a diseased state of the heart and vessels, or from the action of various specific poisons. On the other hand, those varieties of gangrene are *local* which arise from injuries of all kinds, whether applied to the part itself, or to the main artery leading to it, by its ligature or wound.

Some of the varieties of gangrene that have just been indicated, such as those arising from the intensity of the inflammation, and from various traumatic

causes, have already been discussed (p. 116); whilst those that arise from obstructed circulation, or that take the form of specific diseases, are left for our consideration here.

Gangrene from Arrest of Circulation.—Arrest of circulation may act in three ways in inducing gangrene: — 1st, by the arrest of all the blood, arterial, venous, and capillary, in the part, as in *strangulation* by a tight ligature; 2d, by *obstruction of the arteries*, and consequent deprivation of blood; and 3d, by *venous obstructions*, and by consequent over-accumulation of blood. 1st. A part is often purposely strangled by a surgeon in many operative procedures, or its circulation may in this way be arrested, as the result of certain diseased conditions. In either case, the strangulation acts by stopping more or less completely the whole circulation of the part. If it be sufficiently severe, it may kill the tissues outright; as, for instance, when a nævus or pile is tied, all flow of blood to or from the part is suddenly arrested, and its vitality destroyed, the tissues that have been strangled shrivelling, and separating by ulceration along the line of ligature. When the strangulation is not so severe as this, great congestion in the part ensues, consequent on the interference with the return of the venous blood; the part strangled becoming dark and congested, phlyctenæ or vesicles arising on its surface, and effusion taking place into its tissue. Inflammation becoming at last superadded to the effects of the strangulation, and still more embarrassing the circulation of the part, sloughing takes place by the conjoined action of the strangulation and the inflammation; all this we see occurring in a constricted gut.

2d. *Arterial obstructions.*—When a part of the body is deprived of its proper supply of blood, mortification may ensue. This we see occasionally happen when the circulation is arrested through the main artery of a limb by its ligature or wound. Most commonly, when the principal trunk of an artery is obstructed, the collateral circulation is sufficient to maintain the vitality of the part; but should this be interfered with in any way, gangrene ensues from the simple deprivation of that blood which is necessary to the maintenance of its life. Indeed, the sudden loss of a large quantity of blood from the system generally may occasion the death of some of the extreme parts of the body, in which the circulation is naturally most languid. Thus Sir B. Brodie relates the case of a drunken man, who, being bled to an inordinate extent, was seized with gangrene of both feet.

The want of a due supply of arterial blood to the limb may be occasioned in three ways:—1st, by the ligature or wound of the main trunk; 2d, by obstructive arteritis; 3d, by calcification, and consequent occlusion of the vessel. This form of gangrene varies materially, according as it arises from one or other of these causes.

When a limb becomes gangrenous in consequence of the ligature or wound of its main artery, without any other injury to the vascular system, it will be found to become cold, to feel heavy, and to lose its sensibility; at the same time it assumes a dull tallowy-white color, mottled with greyish or brownish streaks. This state of things is chiefly met with in the lower extremity; the integuments of the foot die, become semi-transparent and horny-looking where they are stretched over the tendons of the intsep, and the part thus presents a shrivelled appearance. In the course of a short time, the pallid color will be lost, the part becoming brown or blackish. This form of gangrene may invade the whole of the lower limb, but most commonly is limited to the foot, stopping either just above the ankle, or if not, then immediately below the knee, as Guthrie has observed; the arrest taking place in one or other of these two spots on account of the greater freedom of the collateral circulation here than in other parts of the limb. If any of the large venous trunks become obstructed or otherwise implicated, so that the return of blood through them is interfered with, at the same time that the supply by the arteries is arrested, the limb

generally assumes a greenish-blue color, and rapidly runs into putrefaction. In some of these cases it happens that sloughs of the integument and subcutaneous cellular tissue form, although the limb generally preserves its vitality. The treatment of these forms of gangrene, which are strictly local, is described in the chapter (p. 174) on wounded arteries.

Gangrene may occur from the circulation being arrested by disease taking place in the coats of the arteries. This is the variety of the affection that is commonly called *spontaneous*. It may be the result either of obstructive arteritis, or of plugging up an artery that has undergone calcification or senile degeneration.

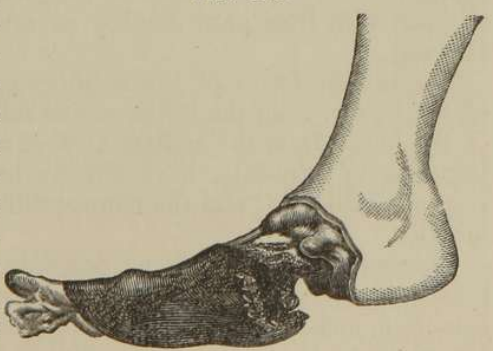
Spontaneous gangrene from acute obstructive arteritis may occur at all ages; in young people as well as in old. It happens as frequently, indeed I believe more frequently, in the upper than the lower extremities, and is of the humid variety. Its pathology and treatment will be fully considered when we come to speak of arteritis.

Fig. 139.

Femoral and tibial arteries obstructed in senile gangrene.

Spontaneous gangrene is termed "senile" when it occurs in consequence of the coats of the arteries becoming rigid and calcified (fig. 139), and unable to maintain the circulation of the limb. It is met with in the lower extremities of people past the middle period of life, and increases as age advances: a sensation of weight in the limb occurs, with coldness, itching, and tingling in the feet, and with cramps in the calves, and the circulation of the part is habitually defective. This condition commonly exists for a considerable length of time before gangrene comes on. In many instances this sets in without any exciting cause; but in other cases the mortification is immediately set up as the result of some slight inflammation accidentally induced; by the excoriation produced, perhaps, by a tight boot, or by a trivial wound in cutting a corn; the inflammation occasioned by this slight injury being sufficient to disturb the balance of the circulation in the already weakened part to so great an extent, that gangrene ensues. This generally makes its appearance in the form of a cold, purple or blackish-red spot on the side of one of the toes; this spot may be surrounded by an inflamed areola, and accompanied by much smarting and burning pain; it spreads by gradually involving the inflamed areola, which continues to extend in proportion as the gangrene progresses. In such cases the toes and feet simply shrivel, without any sign of local inflammation or constitutional disturbance. In one or other of these ways the affection gradually creeps up the limb, invading perhaps one toe after the other, involving the instep and the sole of the foot, and, unless it terminate by the formation of the line of demarcation, or death put an end to the patient's sufferings, it may extend up the ankle or leg. The part that is affected is always black, dry, and shrivelled, resembling closely the

Fig. 140.



appearance presented by a dried mummy; hence it is often termed *mummification* (fig. 140). There is usually considerable constitutional disturbance, sometimes pyrexial at first, but secondarily sinking into an irritative or asthenic form, in these cases, and the disease is generally fatal in from a month to six weeks. I have known the disease continue, however, with very little constitutional disturbance for more than twelve months. In other instances, again, the gangrene being limited to a small extent, the patient may recover.

Gangrene may also occur from inflammation affecting the principal artery of a limb, and perhaps occluding it completely, without any previous disease in the vessel. In these cases there are the usual signs of arteritis, such as tenderness along the course of the vessel, cessation of pulsation in its terminal branches, intense superficial pain in the limb, followed by the rapid supervention of dark, dry gangrene in the whole of the extremity up to the point at which the vessel is inflamed. This affection, of extremely rare occurrence, has been described as *spontaneous* gangrene. In some cases it partakes of the characters of the humid form, owing to the implication of the veins. It is, I believe, most frequently met with in the upper extremities, at least all the instances that I have seen of it have been situated there, and I have observed it most commonly in women, occurring even at an early period of life. It is of the dry variety, in consequence of the arrest of the flow of blood into the limb, and usually occurs in a broken constitution, being frequently fatal by the supervention of typhoid symptoms before any attempt can be made by nature to separate the mortified part; after death, in these cases, the inflamed vessel will be found firmly plugged up by a dense coagulum, which completely arrests the circulation through it. The pathology of the arterial system in reference to these two forms of gangrene, will be more fully discussed in a subsequent chapter.

3d. *Venous obstruction.* — Gangrene may arise from obstruction to the return of blood through the veins of a part, the disease occurring from the circulation being arrested by the overloading of the capillaries with venous blood. Gangrene is especially apt to take place, if the arterial supply is diminished, at the same time that the return of venous blood is interfered with; as when an artery and vein are compressed, or when the femoral vein is wounded accidentally at the time that the artery is ligatured. Gangrene from this cause is always of the moist kind, attended by great swelling from œdema, with discoloration and rapid putrefaction of the part.

This gangrene, from venous obstruction, is also especially apt to occur in those cases in which the heart's action is weakened, or the flow of blood in the aorta lessened, at the same time that the force of the impulse in the arterial system is so lowered that the heart is unable to push the blood through the loaded vessels. Those cases of gangrene of the extremities that are occasionally met with from pure debility, as after fevers, often appear to originate in this way.

The various forms of *traumatic* gangrene, whether arising from the severity of the injury, from the inflammation following it, from the depraved condition of the blood, from the irritation of extravasated fluids, or from the effects of burns, or of frost-bite, have already been considered when treating of these respective injuries; and the more specific forms of the affection we shall shortly describe.

Treatment. — As gangrene proceeds from such a great variety of causes, it must be very evident that no one plan of treatment can be applicable to this condition, and it becomes necessary, not only to modify our therapeutic means according to the cause of the disease, but also with special reference to the constitution of the patient, and with regard to the stage in which we meet with the gangrene; and, indeed, it often requires great tact and experience to accommodate the treatment in this way to the varying phases of the case. I

have already considered the treatment of the inflammatory (p. 104) and the traumatic and local (p. 175) forms of gangrene, and shall, therefore, consider merely in this place the general principles that guide us in the management of those varieties that have been considered as the result of constitutional causes —the *spontaneous* forms; and in these cases the constitutional management of the patient is of greater moment than the local treatment of the disease.

In the *constitutional treatment* of these forms of gangrene, there are three principal indications: 1stly. To remove the cause, if possible, and thus to arrest the gangrene. 2ndly. To support the powers of the system during the process of the separation of the sloughs; and 3rdly. To lessen the irritability of the nervous system.

In the removal of the constitutional cause, we must look wholly to the condition of the patient's system; if this be in an inflammatory or febrile state, we must have recourse to the modified antiphlogistic plan described at p. 86. But the opposite condition, that of debility, may equally occasion or complicate the gangrene, which may recognize an enfeebled state of the circulation of the part, or of the system generally, as its cause, and there may be every possible combination between this and the inflammatory condition. Under these circumstances, it will be necessary to conjoin an antiphlogistic plan of treatment with remedies of a tonic, or even stimulating character. It is this plan of treatment that is commonly found to succeed best in the spontaneous gangrenes; here moderate antiphlogistics are perhaps required in the earlier stages, with a light nutritious diet and mild tonics as the disease advances, and in the later periods, when the constitutional symptoms assume an asthenic character, stimulants should be given. The best stimulants to administer in these cases are wine or porter, according to the patient's habits of life, and these should be given in combination with nourishment, so as not merely to raise the pulse, but to produce a more permanent tonic influence on the system generally. If much depression occur, the medicinal stimulants, more especially ether, ammonia, and camphor, are of material service. The only tonics that are of much value in these cases, are the preparations of bark and some of the vegetable bitters, as gentian and cascarilla; and though the specific virtues that were formerly attributed to them can no longer be accorded, yet, when they do not irritate the stomach, they are of unquestionable service in combating the asthenic symptoms and improving the digestive powers. In these cases I look upon bark or gentian, in combination with the chlorate of potass and ammonia, as of undoubted value.

After the proper employment of means calculated to remove the constitutional cause of the gangrene, the system must be supported against the debilitating effects that accompany the process of ulceration and of suppuration necessary for the separation of the mortified parts. During this period, there is less irritation and more debility, and stronger tonics and stimulants can be borne, but we should be careful not to overstimulate the patient. On this point it is extremely difficult to lay down any rule; every possible variety as to the quantity and quality of food and stimulus being required by different individuals. The safest guides are the state of the pulse and tongue; if they improve, the means employed agree. At the same time hygienic measures should be carefully attended to; cleanliness and free ventilation, with the abundant use of the chlorides, are of the first moment, so that the patient be not poisoned by his own exhalations.

The third indication, that of lessening the irritability of the system that always supervenes, and which is partly owing to the severity of the pain, and partly to the shaken and depressed state of the nervous system, is best carried out by the administration of opium; and although this drug may not act as a specific, as Pott supposed, yet in many cases, but especially in the gangrene of the toes and feet of old people, it is undoubtedly a remedy of the greatest value. A grain of the solid opium may be administered advantageously every 6th, 8th,

or 12th hour, according to the effect it is found to produce, care being taken at the same time that the bowels do not become confined. The hiccup, which is often distressing in these cases, is best remedied by the administration of chloric ether and camphor.

The *local treatment* of the gangrenous part should be conducted on the principles described (p. 104), leaving the separation of the sloughs as much as possible to nature, diminishing the fœtor which occurs, by the use of the chlorides, preventing the absorption of morbid matters by the line of separation, and dressing this with wet lint or calamine cerate, and lastly, endeavoring to heal the ulcer that results on the detachment of the sloughs.

The *treatment of "senile gangrene,"* presenting, as it does, some peculiarities, requires a few words to be specially devoted to it. By some surgeons this disease has been treated on a strictly antiphlogistic plan, on the supposition that the obstruction of the arteries was caused by the inflammation of their coats; this, however, is certainly an erroneous doctrine in a great number of cases; and though inflammation may occasionally affect the calcified coats of an artery, it is always a low form of the disease that does not bear depletion. Sir B. Brodie very justly observes, that in these cases the local precursory inflammation terminates in mortification, because the inflamed part cannot obtain the additional supply of blood that it requires; hence if blood is abstracted from the system, and the action of the heart weakened, the cause of the disease will only be aggravated. But though depletory measures are not admissible, we must guard against running into the opposite extreme, and over-stimulating patients laboring under this disease. Senile gangrene commonly occurs in individuals belonging to the wealthier classes of society, who have lived high, taken insufficient exercise, and consequently got the system into an irritated, plethoric, but enfeebled state. In this condition stimulants and the more powerful tonics are not well borne, they heat the system, accelerate the pulse, and interfere with digestion; and, as Sir B. Brodie observes, it is of great importance in this disease to attend to the state of the digestive organs, in order that nutrition may go on, and that blood of a proper quality may be made. In order to accomplish this, a light, nourishing diet, partly animal and partly vegetable, should be given, and a moderate quantity of wine, beer, or brandy allowed. The bowels must be relieved from time to time by a rhubarb draught or simple aperient pill. It is better to avoid mercury in any form in this disease, as it depresses the system, and hence it should not be used, even as an aperient, unless the state of the liver imperatively required it. If the digestion become impaired, a stomachic, as the infusion of cascarilla, or the compound infusion of gentian with a little ammonia, may be administered. The administration of opium in these cases, as recommended by Mr. Pott, has received the sanction of almost every practical surgeon. Sir B. Brodie's opinion on this point is peculiarly valuable; he says, "If I am not greatly mistaken, the result of a particular case will very much depend on this, — whether opium does or does not agree with the patient." From 2 to 4 grains of opium may be administered in divided doses in the course of the twenty-four hours, the quantity being increased as the system becomes accustomed to its effects. If it disturb the stomach and occasion headache notwithstanding the use of aperients, it must, however, be discontinued, as it will increase the irritation of the system. With respect to the comparative advantages of the depletory and stimulating plans of treatment in senile gangrene, I think it may fairly be stated that neither method should be employed exclusively; that in those cases in which there is much action going on, in which the spread of the gangrene is preceded by a red angry blush, with much pain and heat, low diet and moderate depletory measures will be most useful, whilst on the other hand when it is simply a shrivelling of the toes and feet, without any sign of being preceded by local increased action, or by constitutional disturbance of a febrile type, a tonic or stimulating plan will succeed best.

The local means to be employed in senile gangrene are of a simple character. It is of great importance to keep up the temperature of the limb, and to equalize its circulation as much as possible; this is best done by the application of cotton-wadding or of carded wool, in thick layers around the foot and leg, so as to envelop the limb completely in this material, over which a large worsted stocking may be drawn, or a silk handkerchief stitched. This dressing need not be removed more than once or twice a week unless there is much discharge from the line of separation, then it must be changed more frequently; the gangrened part itself should be covered with a piece of lint, soaked in chlorinated lotions. When the soft parts have been separated, and the bones of the foot exposed, these should be cut across by means of cutting-pliers or a small saw, and the sore that results dressed in the ordinary way with some astringent lotion or slightly stimulating ointment. The Balsam of Peru, either pure or diluted with an equal part of yelk of egg, is a very excellent application in these cases. In the event of the patient recovering, he must be careful to avoid exposure to cold, and to keep the legs warmly clad at all seasons of the year.

The *question of amputation* in cases of gangrene of the limbs is of great importance to the practical surgeon, and is one, on certain points of which the opinions of the best practitioners are still at variance. At first sight it appears rational to cut off a limb that is dead, disorganized, and offensive, and this may be done when the gangrene is, strictly speaking, a local condition; as, for instance, the result of a severe injury; any affection of the constitution in such a case as this being secondary to the local mischief, and dependent on the irritation set up by it, and on the effort made by nature to rid the system of a spoiled member. But when the constitutional disease is the primary affection, and when the gangrene is consecutive to and dependent upon this, it would clearly be useless to cut off the mortified part, as the same morbid action might, and would, be set up in the stump or elsewhere. Hence the broad question of amputation in cases of gangrene turns upon the fact of the mortification being local or constitutional in its origin.

When the gangrene is *local*, therefore, we usually amputate at once. This is especially the case when the mortification results from severe injuries, or is the result of the wound or ligature of an artery. Here, I think, for the reasons that have been given (p. 176), that amputation should be performed as soon as the gangrene has unequivocally manifested itself, without waiting for the line of demarcation. The result of amputation for traumatic gangrene is, on the whole, very unfavorable, the patient very commonly sinking from a recurrence of the disease in the stump, or from the constitutional disturbance that had previously set in; those cases being especially unfavorable in which the cellular tissue of the limb is much infiltrated and disorganized, the affection indeed partaking more of the characters of constitutional disease, with some forms of which it is closely associated.

There are two exceptions to the rule of amputating in traumatic and local gangrene before the occurrence of the line of demarcation, viz., in the case of gangrene from frost-bite, and in that from severe burns; in these injuries it is better to wait for the line of separation to form, and then to fashion the stump through it as the circumstances of the case require.

In gangrene from *constitutional* causes, it is a golden rule in surgery never to amputate until the line of separation has formed; for as it is impossible in these cases to say where the mortification will stop, the amputation might be done either too high, or not high enough; and, under any circumstances, the morbid action would to a certainty be set up in the stump. It is not even sufficient in such cases as these to wait until the line of demarcation has formed before removing the limb; these spontaneous or constitutional gangrenes having often a tendency to remain stationary for some days, and then creeping on, may readily overstep the line by which they had at first appeared to be arrested. Besides

this, the local disturbance and inflammation set up by the amputation might be too great for the lessened vitality of the system or part, and might of itself occasion a recurrence of the gangrene. Hence in these cases it is always well to wait until the line of separation has ulcerated so deeply that there is no chance of the gangrene overleaping this barrier, at the same time that means are taken, by the administration of tonics, nourishing food, &c., to improve the patient's strength and fitness for the operation. So soon as this has been done in a satisfactory manner, and all the soft parts, except the ligaments, have been ulcerated through, the mortified part should be separated, by cutting through the remaining osseous, ligamentous, or tendinous structures, and then means should be taken to fashion the stump that has been so formed by nature. In some cases this will be sufficiently regular to serve every useful purpose after it has cicatrized; in most instances, however, it will be found that the bones protrude to such an extent, or that the ulceration has affected the soft parts so irregularly, that it will be necessary, in order to give the patient a useful limb, to amputate through the face of the stump, or higher up; all this, however, must be left to the discretion of the surgeon, but no procedures of this kind should be undertaken until the patient's strength has been restored sufficiently to bear the operation.

In *senile* gangrene it has recently been proposed to amputate the thigh high up. This practice has been successfully adopted by Mr. Garlike, Mr. James of Exeter, and others, and certainly deserves a trial in all cases in which the health is otherwise good and the constitution tolerably sound. It has not as yet been adopted in a sufficient number of cases to warrant a positive opinion on its merits; but it would appear that for it to succeed, the amputation should be done high up in the thigh, so that there may be a better chance of meeting with a healthy condition of the vessels and good vitality in the limb; the operation being performed on the principle, that this form of gangrene is dependent on local disease obstructing the vessels of the part, and not always on constitutional causes.

CHAPTER XXVI.

GANGRENOUS DISEASES.

BED SORES.

When a part of the body is compressed too severely, or for too long a time, even in a healthy constitution, it loses its vitality, and a local limited slough results; this separates, and an ulcer is left, which cicatrizes in the usual way. But in certain deranged states of the health, more especially when the blood is vitiated and the constitutional powers lowered, as during fever, or when the patient is old, debilitated, or paralyzed, the skin covering those points of the body that are pressed upon in the recumbent position, such as the sacrum, the trochanter, the elbows, shoulders, and heels, becomes congested and inflamed, assuming a dull reddish-brown color, and speedily becomes excoriated without any pain being felt by the patient. If means be not taken to relieve the part from the injurious compression to which it is subjected, and more especially if it be irritated by the contact of fæces or urine, the subcutaneous cellular tissue corresponding to the inflamed patch will be found to have become widely softened and doughy, being converted, with the skin covering it, into a tough

greyish slough, from under which a thin ichorous pus exudes. This slough may extend by a process of undermining of the integuments covering it, and on its separation extensive mischief will be disclosed, the fascia and tendons being exposed, or the bones laid bare, and soon becoming roughened and carious. In some cases, even, the inferior aperture of the spinal canal may be laid open, or death result from a low form of arachnitis, in consequence of the irritation spreading to the membranes of the cord. In other cases, again, the patient dies worn out by discharge and irritation.

The *treatment* of these cases is in a great measure of a preventive character. When a patient is likely to be confined to bed for many weeks, especially by an exhausting disease, steps should be taken, by proper arrangement of the pillows, and by the use of the water-bed and cushions, to prevent pressure being injuriously exercised upon any one part. At the same time cleanliness and dryness should be carefully attended to, by proper nursing, by the use of a draw-sheet, and by furnishing the bedstead with the necessary arrangements of bed-pan, etc. The skin on the exposed parts may be protected by the application of collodion or soap-plaster spread upon wash-leather or amadou, or, what is better, may be strengthened by being washed with spirits of wine, either pure, or having two grains of the bichloride of mercury dissolved in each ounce.

If the skin have become chafed, the removal of pressure is imperative, and the abrasion may be washed over with collodion; if a sore has formed, it may be dressed with the balsam of Peru, either pure or diluted with the yelk of egg, spread upon lint. In these cases, also, the use of the prone couch may occasionally be advantageously substituted for that of the ordinary bed previously employed. When sloughs have formed, their separation must be facilitated by the use of charcoal or chlorinated poultices, and the ulcers that are left should be dressed with astringent and aromatic applications, such as catechu, tincture of myrrh, etc.; but no dressing that the surgeon can apply will cause these ulcers to heal, unless the patient's general health improve, and then they will speedily get well under simple treatment.

SLOUGHING PHAGEDÆNA.

This affection, which is also commonly known by the names of *hospital*, *contagious*, or *pulpy gangrene*, is a disease characterized by a rapidly destructive and spreading ulcer, covering itself as it extends by an adherent slough, and attacking open sores and wounds. It is rarely met with in its fullest extent, except in military practice; the accumulation of the wounded, and the want of the necessary cleanliness and attention during an active campaign, appearing to dispose to it. It used formerly to desolate the civil hospitals, but, thanks to the sanitary measures that are now so generally adopted in these institutions, it has almost disappeared from them, though still an outbreak of it occasionally takes place. During the last few years, it has been met with in most of the London hospitals, and has twice made its appearance in that of the University College.

When sloughing phagedæna invades a wound that is previously perfectly healthy, the surface of the sore becomes covered with grey, soft points of slough, which rapidly extend, until the whole of the ulcer is affected. At the same time it increases rapidly in superficial extent, and commonly in depth; the surrounding integument becomes œdematous, swollen, and of a livid red color; the edges of the ulcer are everted, sharp cut, and assume a circular outline, and its surface is covered with a thick, pulpy, greyish-green tenacious mass, which is so firmly adherent to the sore that it cannot be wiped off from it, being merely moved or swayed to and fro when an attempt is made to clean it. There is usually some dirty yellowish-green or brownish discharge.

and occasionally some bleeding; the pain is of a severe burning, stinging, and lancinating character, and the fœtor from the surface is considerable. The ravages of this disease, when fully developed, are very extensive. The soft parts, such as the muscles, cellular tissue, and vessels, are transformed into a grey pulpy mass, and the bones are denuded and necrosed. The larger blood-vessels resist the progress of the disease longer than any other parts, but may at last be exposed, pulsating at the bottom of the deep and foul chasm. There is little risk of hemorrhage taking place, however, in the early stages; but when the sloughs are separating, an artery may give way, and bleeding to a dangerous or fatal extent ensue. Hennen states that there is most danger of this happening about the eleventh day. When the sloughs are thrown off, in the form of reddish-brown or greyish-green viscid and pulpy masses, a very sensitive granulating surface is left, having a great tendency to bleed, and to be again invaded by the sloughing action.

Blackadder has described an ulcerated form of this affection, in which a vesicle containing a bloody ichor forms, with a hot, stinging pain; this breaks, leaving a circular ulceration about the size of a split pea. The ulceration once formed, rapidly extends by sharp-cut edges into the surrounding integument.

On the two occasions that I have had the opportunity of witnessing out-breaks of this disease, in the University College Hospital, the surface of the wound affected became rapidly covered with a yellowish-grey pultaceous slough. In some cases there was hemorrhage, but most commonly a small quantity of fetid discharge only was poured out, the edges of the sore became sharp-cut and defined, and the ulceration extended further in the skin by an eighth or a quarter of an inch than in the subjacent cellular tissue. In the majority of instances, the disease was confined to the skin and cellular tissue, exposing, but not usually invading, the muscles and bones, though in some cases these were affected. The ulcers, which had a somewhat circular shape, were surrounded by a dusky inflamed areola of some width. When once the morbid action was stopped, they cleaned rapidly, throwing out large vascular granulations.

The *constitutional symptoms* are inflammatory in the first instance, with a tendency to asthenic and irritative fever as the disease advances. In the majority of cases they follow the local invasion of the sore; Blackadder, Rollo, Delpech, and Wellbank, have all found this to be the case, and in the instances at University College Hospital it certainly was so. Hennen and Thompson, on the other hand, state that the constitutional symptoms precede the local ones. This discrepancy of observation may be explained by the difference in the cause of the disease; if it occur from contagion, the constitutional symptoms will be secondary; if from causes acting on the general system, they may probably be primary, to the local affection.

All wounds and sores are liable to be attacked in this way, but the disease most frequently affects those that are of recent origin; the more chronic affections, and those that are specific, very usually escape.

The *causes* are of various kinds; primarily it commonly originates from overcrowding in hospitals, from want of cleanliness, ventilation, and change of dressings; from that accumulation, indeed, of animal exhalations arising from the sick and wounded, which is a source of various forms of low fever and of allied diseases; and when so occurring, this disease may be taken as an evidence of the infringement of the sanitary laws in accordance with which the arrangements of the institutions should be regulated. But though it commonly has its origin in this way, especially in the crowding of military hospitals after a hard-fought action, it is met with out of hospitals. Well-marked cases of this affection, some of a very severe character, have at times occurred amongst the out-patients at the University College Hospital. In these cases, as in many others, it was probable that the disease was occasioned by the neglect of hygienic conditions in the close and ill-ventilated houses of the poor aided

possibly by some atmospheric or epidemic influence; influenza, erysipelas, and phlebitis being also very prevalent. This had been observed at the time of the first occurrence of the disease at our hospital, in 1841, and I think it is difficult not to recognize a similarity of cause in these different affections. When once it has occurred it may rapidly spread by contagion, though there is no evidence to show that it is of an infectious character. Hence the necessity of preventing its being spread by nurses or attendants, by the incautious use of sponges, and of destroying the dressings used by the patients.

In the *treatment* of this affection the first point to attend to is to prevent the extension of the disease to patients that are not as yet affected by it. This may be done by separating those that have been seized with it, from the healthy, by ventilating the wards, washing the floors with a solution of the chlorides, whitening the walls, and fumigating the apartment with chlorine gas.

The extension of the sore must be stopped by the free application of fuming nitric acid, or of the actual cautery to its edges and surface. I have used both these agents, but give the preference to the nitric acid if strong and freely applied, the sides and edges being well sponged with it. The actual cautery is, however, very useful in those cases in which the surface to be destroyed is very extensive, or if there is a tendency to hemorrhage. Should it not reach the deeper portions of the sore, nitric acid may be freely sponged into them. After the cauterization a strip of lint soaked in a strong solution of the watery extract of opium, should be laid around the margin of the ulcer, so as to cover the surrounding areola; and the separation of the sloughs must be encouraged by the continued application of charcoal, yeast, or chlorinated poultices. When they have separated, and the surface of the sore has cleaned, it may be dressed with a lotion composed of one grain of the sulphate of copper, and five of the watery extract of opium to the ounce of water. The granulations, which are very luxuriant and vascular, will be found to skin over with great rapidity, and the cicatrix like that of an ordinary burn will contract very firmly.

Should arterial hemorrhage occur, it must be arrested by the application of a ligature to the bleeding point, but if this does not hold, as will probably be the case from the softened state of the tissues, the actual cautery must be applied, or, the limb at last removed in the event of all other means failing.

In some cases it happens that though the sloughing action is checked at one part of the surface, it has a tendency to spread at another. When this is the case it may be necessary to apply the caustic or cautery repeatedly. In others again, the sloughing action cannot be stopped, but opens large arteries, and destroys the greater part of the soft tissues of a limb, and then it may be a question whether amputation should be performed during the spread of the disease, or the patient left to die of hemorrhage or exhaustion. Such a contingency is not of common occurrence, but yet it may happen, and the operation be successful, as appears by the following case, though there would necessarily be great danger from a recurrence of the disease in the stump. The wife of a butcher applied at the hospital, with a slight wound of the forearm, inflicted by a hook. It was dressed in the ordinary way, but in the course of a few days she returned with extensive sloughing phagedæna of the part, she was immediately admitted, and the disease was arrested by the energetic employment of the local treatment above described; not, however, until after considerable destruction of the tissues on the inside of the forearm had taken place. She left the hospital before the wound was completely cicatrized, and returned in a few days with a fresh attack of the disease more extensive and severe than the first, and which could not be permanently stopped, either by the actual cautery or nitric acid. The radial artery was opened and required ligature, and the whole of the soft parts, from the wrist to the elbow, were totally disorganized, and the bones exposed. There was now very severe constitutional irritation, and the case was evidently fast hastening to a fatal termination. Under these

circumstances I amputated the arm midway between the shoulder and elbow; and, notwithstanding that the local disease was progressing at the time of the operation, and the great constitutional disturbance that existed, the patient having a pulse of 160 to 170, at which it continued for more than a fortnight, she made a good recovery; to which the free administration of stimulants greatly contributed.

The *constitutional treatment* of this disease must have for its object the removal of the combined state of debility and irritation in which we find the patient. The bowels should be kept freely opened by warm aperients; as nourishing a diet as the patient will take, with a liberal supply of stimulants, should be ordered, and these may be increased by the addition of the brandy-and-egg mixture, or of ammonia in proportion as depression comes on. At the same time I have found great advantage from the administration of a mixture of carbonate of ammonia, gr. v.; chlorate of potass, ℈j; compound tincture of bark, ℥j; decoction of bark, ℥jss, every four or six hours; or if the patient will bear it, quinine in full doses, from five to seven grains of the sulphate every six hours, with an opiate at bed-time, or more frequently if there be much pain and irritation.

GANGRENOUS STOMATITIS, OR CANCRUM ORIS.

A peculiar phagedænic ulceration, closely resembling the last-described affection, is occasionally met with in the mouths of ill-fed children living in low and damp situations, most commonly occurring between the second and sixth or eighth years, but more especially about the period of the second dentition.

The mildest form of this affection presents itself as small, deep, and foul greyish ulcers, situated on the inside of the lips or cheeks, and attended with a red spongy condition of the gums and much fœtor of the breath. In these cases, good food and air, with nourishing diet, the administration of bark, with the chlorate of potass, and the use of chlorinated lotions, with the honey of borax, will soon bring about a cure. The Spanish snuff (Sabilla) applied to the sore mouth, or placed in a small cambric bag on the tongue, has a very good effect in cleansing these sores, and especially in soothing irritation.

In the more severe form of the affection, the true *cancrum oris*, we find, commonly during convalescence from some of the eruptive diseases of childhood, or, if mercury have been incautiously administered during a weak state of the system, that one of the cheeks becomes swollen, brawny, tense, and shining, being excessively hard, and presenting a red patch in its centre. In consequence of this swelling, it is often difficult to open the mouth; but if the surgeon can gain a view of its inside, he will see a deep and excavated foul ulcer opposite to the centre of the external swelling, covered with a brown pulpy slough. The gums are turgid, dark, and ulcerated, the saliva is mixed with putrescent matters, and as the ulceration in the mouth extends, the swelling sloughs, and a large, dark, circular gangrenous cavity forms in the cheek, opening through into the mouth; during all this time the child suffers little, but, as the disease advances, it commonly becomes drowsy, and at last dies comatose. When fully developed, this affection is most fatal. Rilliet and Barthez state that not more than 1 in 20 cases recovers.

The *treatment* of cancrum oris is that of hospital gangrene; the sloughing mass should be deeply cauterized with nitric acid, but not with the actual cautery, lest the cheek be destroyed, the mouth syringed with the dilute chlorides, and the system supported with beef-tea, wine, and ammonia, in doses proportioned to the age of the child. After the cure of the disease, the cheek may be deeply cicatrized, contracted, and rigid, much in the same way as after a burn, requiring possibly some plastic operation in order to enable the child to open its mouth properly.

BOILS.

A *boil* is a hard circumscribed tumor of a violet or purplish-red color, flattened, though somewhat conical, suppurating slowly and imperfectly, and always attended by a small conical central slough of cellular tissue called a *core*. It consists of an inflammation of the subcutaneous cellular tissue, and of the under surface of the true skin. The tension and hardness accompanying this affection render it extremely painful and annoying to the patient. It is most commonly seated in the thick skin of the back, the neck, or the nates.

Boils most frequently make their appearance in young people, but are common enough at all ages, and are usually seen either in very plethoric or in very enfeebled constitutions, often following some of the more severe febrile diseases, and attending convalescence from them. In other cases, the system appears to have fallen into a cachectic state, often without any evident cause, and this terminates by a critical eruption of boils. A sudden change in the habits of life, as from sedentary to active pursuits, a course of sea bathing, &c., will also occasion them. They are commonly met with in the spring of the year, but may occur at all seasons, and are occasionally epidemic, as has been the case during the last few years in London. When once they take place, they are often extremely tedious, crop after crop continuing to be evolved.

In the *treatment* of boils, the constitutional condition of the patient, on which the disease is dependent, requires to be carefully attended to. As they most commonly occur in a cachectic and broken state of the system, the preparations of iron will be found to act beneficially. This mineral may very advantageously be administered in combination with ammonia and chlorate of potass, after which the patient may be put upon a course of sarsaparilla or bark with the mineral acids. Should this fail, and the boils appear to be dependent on a low state of health, quinine in large doses, in combination with sulphuric acid, may be advantageously used. In other instances again, and especially if the disease be associated with pompholyx, arsenic will be found of service. In many cases, however, the surgeon will be baffled whatever be the treatment he adopts, the tendency to the disease appearing rather to terminate of itself, than brought to a close by remedial measures. During this plan of treatment, it is necessary to keep the bowels free by the occasional administration of an aloetic purgative. If the boils occur in young people who are otherwise tolerably healthy, or in plethoric individuals, this tonic plan of treatment will not succeed; but saline aperients and the liquor potassæ, in doses of from twenty to thirty minims twice a day, will usually speedily remove the affection. In some cases yeast may be advantageously administered.

The *local treatment* of this disease is of a simple character; when they are forming, the most useful dressing is a warm spirit lotion kept applied with lint and oiled silk; as suppuration comes on, a linseed meal poultice, either simple or made with port wine, may be advantageously applied. Most commonly the boils may be allowed to break, when they discharge a thick pus, together with the central core, thus leaving a small cavity in and under the skin, which, however, soon fills up. The surgeon may in some cases find it necessary to open them with a crucial incision if they are large, and do not appear disposed to break of themselves. When the boils commence as a small irritable pustule, they may occasionally be kept back by touching the point of this with nitrate of silver, or a saturated solution of the bichloride of mercury.

CARBUNCLE.

A carbuncle consists essentially of a circumscribed and limited inflammation of the subcutaneous cellular tissue, rapidly running into suppuration and slough Indeed, the formation of pulpy greyish or ash-colored sloughs, whether re-

sulting from the specific nature of the inflammation, or from the strangulation of the parts by the accumulation of serum and blood, is characteristic of the disease.

A carbuncle begins as a flat, painful, hard, but somewhat doughy, circumscribed swelling of the integuments and subjacent cellular tissue. It is of a dusky red hue, slightly elevated, but never losing its flattened circular shape; as it increases in size, the skin covering it assumes a purple or brownish-red tint, becomes undermined, and gives way at several points, forming openings through which ash-grey or straw-colored sloughs appear, and from which an unhealthy purulent discharge scantily issues. The size of these swellings varies from one to six inches in diameter; most commonly they are about a couple of inches across. Carbuncles are generally met with on the posterior part of the trunk or neck, being rarely seen anteriorly, or on the extremities. I have, however, had to treat a very large carbuncle situated on the abdomen, and have met with them on the shin, forearm, forehead, and often on the face. The constitutional disturbance attending this disease is always of the asthenic type, the complexion is peculiarly sallow or yellow, the pulse feeble, and tongue loaded; and if the tumor be large, or is seated on the head, a fatal termination may take place, the patient sinking into a typhoid state.

This affection, with many points of resemblance, yet differs from boils in its greater size, the dusky red of the inflamed integument, its broad flat character, and the large quantity of contained slough in proportion to the small amount of purulent discharge. Unlike boils, carbuncle is very rare in young people, and never occurs in robust individuals. Indeed, it is always occasioned by, and is by itself indicative of a broken state of the constitution, being usually met with in individuals of a debilitated and irritable habit of body who have passed the middle period of life.

The *treatment* of carbuncle consists in supporting the constitutional powers by the use of the preparations of bark in combination with ammonia, dietetic stimulants, and such nourishment as the patient will take, care being had at the same time to clear out the bowels well, as the intestinal canal in these cases will often be found to be offensively loaded. The local treatment consists in making an early and free crucial incision through the whole thickness and extent of the swelling. If the sloughs that are now exposed be loosened, they must be removed, and if not completely detached, the part must be covered with linseed and port wine poultices, and when the sloughs have cleaned off, the sore that is left should be dressed with Balsam of Peru, creasote, or the unguent Elemi.

There are two other gangrenous diseases, the *malignant pustule*, and a peculiar dry gangrene of the extremities, induced by eating spurred rye, and hence called *ergotism*. These affections, however, are so rarely met with in this country, that their consideration need not detain us.

CHAPTER XXVII.

ERYSIPELAS.

Erysipelas is an affection that so frequently and seriously complicates most other surgical diseases and injuries, that its study is of the utmost importance to the practical surgeon. It usually manifests itself as a peculiar and distinct form of inflammation; as much so as any of the other varieties, the adhesive,

the suppurative, the ulcerative or the gangrenous. Erysipelas, or, as it may be termed, the *erysipeloid inflammation*, including all those varieties of this condition that are usually spoken of as "*diffuse*," has a remarkable tendency to spread or diffuse itself with great rapidity by continuity of surface, to change its seat, and not to be limited by any adhesive action. It may extend itself over any continuous surface; the skin, the cellular tissue, the mucous and serous membranes, and the lining membrane of arteries, veins, and lymphatics, are all liable to be affected by it. Hence, to describe it as a *cutaneous* disease, as has often been done, is in the highest degree incorrect and unphilosophical, and evinces a very limited acquaintance with its true nature. Indeed, not only must we look upon erysipelas as a disease that may affect any surface, external or internal, but we must consider the constitutional disturbance that takes place in erysipelas as the essential disease. This, it is true, is usually complicated with diffuse inflammation of the integument, and then constitutes one of the ordinary forms of erysipelas. But a constitutional fever may occur of precisely the same type as that which we observe to precede and to accompany the local inflammation without any such complication. This I had especial occasion to observe in a very fatal outbreak of erysipelas that took place in one of my wards a few years ago. On that occasion, all the cases in which the cutaneous form of erysipelas appeared were marked by severe constitutional disturbance, attended by much gastro-intestinal irritation. But precisely the same type of general febrile symptoms, and the same irritation of the stomach and bowels, occurred in patients in the same ward, in whom no local or surface evolution of the disease took place, as in those affected by the ordinary cutaneous form of it. The true pathology of the diffuse, low, or erysipelatous inflammations has yet to be made out. They are all closely connected with one another, and are evidently blood or constitutional diseases, under whatever name they go. The similarity of causes, of effects, and of constitutional disturbance, makes it probable that they are all essentially dependent on one common condition of the blood, and that the particular local manifestation that occurs, whether it be erysipelas, phlebitis, low cellulitis, or diffuse abscess, is secondary to this, and perhaps in some degree accidental.

A chief characteristic of this erysipeloid fever is its incompatibility with the localization of any inflammation that may exist at or occur after its invasion; and hence, when it attacks the system, it causes already existing inflammations to assume a diffuse or spreading character, extending themselves over any surface on which they happen to be situated. It is especially apt, in this way, to cause those inflammations to spread which have not already been localized, by the deposit of adhesive matter. Hence, recent wounds are more liable to be affected by it than granulating ones, in which the inflammation has already taken on a plastic character, which requires to be overcome before the diffuse form can set in.

The constitutional fever in erysipelas almost invariably at first assumes the sthenic form, but very speedily runs into an asthenic or irritative type, with a quick feeble pulse, brown tongue, pungent hot skin, and muttering delirium. The disease is truly an affection of debility; it is in consequence of the want of a sufficient degree of power in the part, or in the system, for the deposit of plastic matter, and the limitation of the inflammation by this, that the local affection spreads itself unchecked along the surface it invades. The tendency that invariably exists in erysipelas to the occurrence of sloughing and suppuration of the affected tissues, is a further indication of the asthenic and low character of the disease. This view of the nature of the constitutional disturbance in erysipelas is of great importance in reference to the treatment of the disease, as it demonstrates the necessity of not lowering the patient's powers too much during the early period of the affection, when it often temporarily assumes a truly sthenic character.

Erysipelas is especially apt to become complicated with low visceral inflammation; the membranes of the brain, the bronchi and lungs, or the gastro-intestinal mucous surface, are commonly implicated in this way; and it is often through these complications that death results.

Causes.—Erysipelas may arise from causes existing in the patient himself, or from the conditions by which he is surrounded or to which he is subjected. It commonly originates primarily in want of attention to the hygienic conditions that should surround a patient; and is one of the penalties inflicted by Nature on those who neglect or are incapable of attaining those prime requisites of health—good food, temperance, cleanliness, and pure air. Were these attended to as they should be, erysipelas and the allied diffuse inflammations would scarcely be met with. Some persons appear to be naturally predisposed to erysipelas to so great a degree, that the application of cold or slight stomach derangement, or a trivial superficial injury may excite it. This predisposition to erysipelas most commonly takes place in individuals of a plethoric and gross habit of body; those especially who have a tendency to gout appearing to be liable to the ready occurrence of the disease. But this predisposition is most generally acquired by habitual derangement of health, and is especially induced by any of the depressing causes of disease, such as over-fatigue, anxiety of mind, night watching, and habitual disregard of hygienic rules as to diet, exercise, air, &c. The habit of body, however, in which erysipelas is most frequently met with as a consequence of very trivial exciting causes, is that which is induced by the habitual use of stimulants to excess. It is more especially in that state of the system characterized by an admixture, as it were, of irritability and of debility, in which no plastic lymph is deposited as the result of inflammation, but in which this condition is followed by a rapid tendency to the formation of pus and slough, and to extension of disease in a diffuse form, that erysipelas is so very readily induced. This condition of body is met with amongst the laboring poor as the result of the privation of the necessaries of life, conjoined with the habitual over-use of stimulants and exposure to the various depressing causes of diseases, arising from bad food, impure air, &c. Amongst the wealthier classes it occurs as a consequence of high living, want of exercise, and general indulgence in luxurious and enervating habits.

Some diseased states of the blood appear to predispose, in the highest degree, to the supervention of erysipelas. This is especially the case in diabetes and in granular disease of the kidneys attended by albuminuria. As a consequence of renal disease, erysipelas will occur idiopathically, or from the most trivial causes; a scratch, the sting of an insect, or any of the minor operations in surgery, more especially about the lower part of the body, will occasion it. And not only is it readily induced in this way, but it will extend in an uncontrollable manner in these states of the system, there being apparently in them an utter want of limiting or reparative power in an inflammation however set up.

Amongst the circumstances that surround the patient, and that tend to the production of this disease, season of the year and atmospheric changes exercise a marked influence. Not only is erysipelas much more frequent in the spring and autumn than at other seasons of the year, but we not unfrequently find it coming on suddenly on the setting-in of cold easterly winds, or on the occurrence of sudden atmospheric vicissitudes. So also erysipelas often assumes an epidemic character, as the result of those peculiar, but, at present, inexplicable conditions of the atmosphere, in which disease generally assumes a low type, and in which epidemic catarrhs, influenza, phlebitis, and other allied affections prevail. Epidemic erysipelas is almost invariably of a low form, and is very commonly associated with some peculiar train of visceral complication that distinguishes the particular outbreak of the disease.

But not only is erysipelas epidemic, it is also contagious. The contagion of

erysipelas, after having been repeatedly denied, can I think no longer be contested. Travers, Copland, Bright, Nunneley, and others have adduced cases in proof of its contagious character, and instances have repeatedly fallen under my own observation, in which erysipelas, often unfortunately of a fatal form, has been communicated to the servants, nurses, or relatives of patients affected by it. A remarkable proof of the contagious nature of erysipelas occurred in the spring of 1851, in one of my wards at the University College Hospital. The hospital had been free from any cases of the kind for a considerable time, when on the 15th of January, at about noon, a man was admitted under my care with gangrenous erysipelas of the legs, and placed in Brundrett Ward. On my visit, two hours after his admission, I ordered him to be removed to a separate room, and directed the chlorides to be freely used in the ward from which he had been taken. Notwithstanding these precautions, however, two days after this, a patient, from whom a necrosed portion of ilium had been removed, a few weeks previously, and who was lying in the adjoining bed to that in which the patient with the erysipelas had been temporarily placed, was seized with erysipelas, of which he speedily died. The disease then spread to almost every case in the ward, and proved fatal to several patients who had recently been operated upon. In several instances patients were affected with the constitutional symptoms without any appearance of local inflammatory action, but characterized by the same gastro-intestinal irritation that marked the other cases.

Erysipelas may not only spread in this way from patient to patient, but any diffuse inflammation, as phlebitis, inflammation of the absorbents, low or puerperal peritonitis and pyemia may give rise to external erysipelas, and in its turn be occasioned by it—a strong argument in favor of the allied nature of all these affections. Then again the contact of dead or putrescent animal matters with recent wounds may occasion it. In this way the disease is not unfrequently originated in hospitals by dressers going direct from the dead house, and especially from the examination of the bodies of those who have died of diffuse inflammation, to the bedside of patients without taking sufficient care to wash their hands or change their clothes. For this reason also it is of great consequence that the same instruments be not used for practising operations on the dead, and performing them on the living body.

The principal exciting cause of erysipelas is certainly the presence of a wound. It is chiefly recent wounds, however, that are affected by it; when once the adhesive or suppurative inflammation is set up, the wound is not so liable to take it on unless it be in bad constitutions, the formation of limiting fibrine appearing to lessen the liability to the occurrence of the disease. When erysipelas is epidemic, it is well for the surgeon not to perform any operation that can conveniently be postponed until it is less rife; and in no case should a patient on whom an operation has recently been performed be put in a neighboring bed, or even in the same ward, as a case of erysipelas. The size of the wound has little influence on the occurrence of erysipelas, which takes place as readily from a small as from a large one. The more severe forms of erysipelas however, chiefly occur in those cases in which the fasciæ of the limbs are opened up, when the disease may spread through the deeper intermuscular planes of cellular tissue. Injuries about the head and hands are those that are most liable to be followed by this disease.

But though we must constantly bear in mind the constitutional nature of erysipelas, it will be more convenient and practical to describe it as it affects different tissues and organs. With this view, we may divide it primarily into *external* and *internal* erysipelas.

By EXTERNAL ERYSIPELAS is meant that variety of the disease which affects the skin and subcutaneous cellular tissue. This form of the affection has been described with an absurd degree of minuteness so far as the transitory and

accidental characters of its duration, shape, and appearance are concerned, by many of the writers on the Diseases of the Skin, who, in their anxiety to record minute and accidental shades of difference in appearance, have entirely lost sight of the true nature of the disease. The division adopted by Lawrence into the *simple*, the *œdematous*, and the *phlegmonous* forms, is a practical arrangement that is commonly adopted by surgeons. I prefer, however, and shall adopt the division made by Nunneley in his very excellent work on erysipelas, as founded on the true pathology of the affection. He arranges external erysipelas under the *cutaneous*, the *cellulo-cutaneous*, and the *cellular* varieties.

1st. The *cutaneous erysipelas* is the slightest form of the disease, implicating merely the skin; it comprises many of the species of *erythema* of different writers, and corresponds to the *simple erysipelas* of Lawrence.

The *symptoms* of this affection are as follows: — A patient is seized with rigors, alternate chills and flushes, followed by headache, nausea, a quick pulse, a coated tongue, and hot skin; in from twenty-four to forty-eight hours the rash appears, though sometimes it comes out simultaneously with the constitutional disturbance. If there be a wound, the secretions of this dry up, and the margins become slightly swollen, and affected by the red blush. If the disease occur idiopathically without a wound, it most commonly appears upon the face, next upon the legs, and lastly upon the trunk. The rash is of a uniform but vivid rosy red hue, sometimes becoming dusky, and always disappearing on pressure; it usually fuses away into the color of the healthy skin, but is sometimes distinctly margined. It is accompanied by some slight œdematous swelling, which is often considerable where the cellular tissue is loose, as in the eyelids and scrotum, and there is usually a stiff burning sensation in the part. Vesicles or blebs often form, containing a clear but hot serum, which speedily becomes turbid, and dries into brawny desquamation. The redness may spread rapidly along the limb or trunk, or if the face is affected, travel quickly from one side to the other, causing such swelling of the eyelids as to close them, and giving rise to much tensive pain in the ears. Sometimes the disease disappears in one part of the body, reappearing in another. This, which is the *erratic* erysipelas, is often a dangerous form of the affection, occurring in advanced stages of pyemia, and indicating approaching death. In these varieties of idiopathic erysipelas, Arnott states that the fauces are always involved. This affection usually disappears without inducing any serious mischief in the part affected, but in some cases abscesses form, more especially in the loose cellular tissue of the neck and of the eyelids. In other cases again, œdema of the part continues with some irritability and redness of the skin and peeling of the cuticle; and in some rare cases the simple erysipelas seems to take on a gangrenous or sloughing character, especially about the umbilicus and genitals of young children.

The *constitutional symptoms* of the cutaneous or simple erysipelas, present every variety between the sthenic and asthenic forms of inflammatory fever. When the disease occurs in London, it certainly most frequently assumes a low type. There is also in most cases a good deal of derangement of the digestive organs, the tongue being much coated, with tenderness about the epigastrium, dark offensive evacuations, and not unfrequently diarrhœa. When the scalp is affected, severe headache, with symptoms of cerebral inflammation, are commonly met with. Most frequently recovery takes place by the gradual subsidence of the symptoms; this form of the disease seldom proving fatal unless the scalp is affected, and the brain consequently implicated.

2nd. The *cellulo-cutaneous* or *phlegmonous erysipelas* differs from the variety just described, in the degree of inflammation, and the depth to which the tissues are affected. The intensity of this form of inflammation is such as invariably to terminate, if left to itself, in diffused suppuration and sloughing of the tissues. In depth it invariably extends to the subcutaneous cellular tissue, and

though generally bounded by the fasciæ lying beneath this, not unfrequently implicates these if they have been opened up, extending to the inter-muscular cellular planes, the sheaths of the tendons, and other deep structures of the limb or part.

The cellulo-cutaneous or phlegmonous erysipelas is ushered in by the ordinary symptoms of inflammatory fever, accompanied or followed by the signs of severe inflammation in the part affected. The redness is uniform, of a deep scarlet hue, and pretty distinctly bounded; the pain is from the first pungent and burning, though it may soon assume a throbbing character; the swelling, at first soft, diffused, and admitting of distinct pitting, soon increases, and becomes tense and brawny, the skin being evidently stretched to its full extent, and the limb appearing perhaps to be double its natural size. Large vesications or blebs, containing sero-purulent fluid, sometimes of a sanious tinge, make their appearance in many cases. This is the condition that usually continues up to the sixth or eighth day after the invasion of the disease, during the whole of which time the constitutional symptoms have presented the ordinary type of sthenic inflammatory fever; about this time, however, a change commonly takes place, either for better or worse. If, under the influence of proper treatment, and in a tolerably healthy constitution, the inflammation subsides, resolution takes place, with a gradual abatement of all the symptoms. If, however, as usually happens, the disease runs on to more or less sloughing or suppuration of the part, no increase of the swelling, pain, or redness takes place, but, on the contrary, some diminution in these signs may occur, giving rise to an apparent, though deceptive amendment in the patient's condition. The skin becomes darkly congested, and the part, instead of being tense and brawny, has a somewhat loose, soft, and boggy feel, communicating a semi-fluctuating, doughy sensation to the fingers. This change from a tense brawny state to a semi-pulpy condition is indicative of the formation of pus and slough beneath the integument, and should always be anxiously watched for by the surgeon. It must be remembered that it occurs without any material change in the size, the color, or the general appearance of the part, but can only be detected by careful palpation of it; hence the necessity of the surgeon daily examining with his own fingers the state of parts inflamed, and neither trusting to the reports of others, nor to the general appearance of the diseased structures, for the probable condition of the subjacent tissues. If an incision be now made into the affected part, the cellular membrane will be found loaded with an opalescent fluid distending its cells, but not flowing from the wound; the retention of this fluid in the cellular tissue giving a gelatinous appearance to the sides of the incision, which rapidly degenerate into slough and pus. If the alteration in structure have advanced to a stage beyond this, the cellular tissue will be found to have been converted into dense masses of slough, lying in the midst of thin and unhealthy ichorous pus; these have not inaptly been compared in appearance to masses of decomposed tow, of wet chamois leather, or to the membranes of a fœtus a few months old. Whilst these changes are going on below the surface, the skin, at first congested, becomes somewhat paler, and assumes a white or marbled appearance, rapidly running into black sloughs, and being undermined to an immense extent by large quantities of broken-up cellular tissue and of ill-conditioned pus, without any appearance of pointing, however extensive the subcutaneous mischief may be. These destructive changes expose muscles, fasciæ, and blood-vessels, and may induce necrosis of the bones or destroy the joints. They occur most readily in those parts of the body that possess the lowest degree of vitality, and hence are more common in erysipelas of the legs than in the same affection of the scalp. If the patient recover, there will be tedious cicatrization of the deep cavities that are left, or considerable œdema, often of a solid character, a kind of false hypertrophy of the part, which may continue for some considerable time. In other cases again there may be such extensive local destruction or gangrene of the soft

tissues, with exposure and death of the bones or suppuration of the joints, that amputation of the limb may be required as a means of saving the patient's life. No operation of this kind, however, should ever be practised for the after-consequences of erysipelas, unless these be strictly localized with no tendency to spread, all specific constitutional fever having been completely removed, except such as is of a hectic character, and dependent on the exhausting influences of the suppuration and disorganization of the tissues.

During the progress of these local changes, the constitutional symptoms have assumed corresponding modifications. At first of an acute inflammatory character, when suppuration and sloughing have set in, the fever often suddenly assumes an asthenic form, although in some cases there is no diminution in the severity of the symptoms, until after an attempt for a few days to bear up against the exhausting influence of the disease, the constitution gradually gives way, and death speedily supervenes. If the patient survive the stage of sloughing, and if the discharge continue abundant, hectic with diarrhœa, gastro-intestinal irritation, metastatic abscesses or pyemia may carry him off. If recovery eventually take place, it may be at the expense of a constitution impaired and shattered for years. This disease is most dangerous in the old and infirm, or in young children. The immediate danger is always greatest when the head is affected, from the extension of the disease to the membranes of the brain, and the supervention of erysipelatous arachnitis. The remote danger from the effects of suppuration, necrosis, and inflammation of the joints, is greatest when the lower extremities are the seat of erysipelas.

A variety of the cellulo-cutaneous erysipelas has been described as *œdematous* erysipelas. By this is meant not merely that effusion into the cellular tissue which occurs in all the varieties of the disease, but a peculiar form, specially marked by œdema of the cellular tissue, with less inflammation of the skin than usual. There is much swelling, which pits deeply, with but little pain or tension, and but moderate redness of the skin; the constitutional symptoms are less marked than in the other varieties of the disease; it is principally met with in old people, or in persons of a dropsical tendency, in whom it occurs especially about the legs, scrotum, or labia, sometimes giving rise, by the effusion of a seroplastic fluid, to permanent and solid enlargement of these parts.

3d. The *cellular erysipelas*, or as it is often termed, *diffuse inflammation of the cellular tissue*, or *cellulitis*, is a disease that has been particularly described by Duncan, Arnott, Lawrence, and Nunneley. It always arises from a wound or injury, often, however, of an apparently trivial character, and most commonly affects the sub-cutaneous cellular membrane, though occasionally it extends to the sub-aponeurotic tissue, and then is a more severe and dangerous affection. Though commonly arising as a consequence of ordinary injuries, it is especially apt to follow those in which there has been any inoculation of animal poisons, as in dissection wounds, the stings of insects, and the bites of venomous reptiles. In whatever way arising, it is characterized by the rapidity and extent of the sloughing of the affected tissue, and by great depression of the powers of the constitution. That the diffuse inflammation of the cellular tissue, whether it is limited to a finger, or implicates the cellular membrane of half the body, is a variety of erysipelas affecting this membrane primarily, and the skin secondarily, there can be no doubt. The points of resemblance between cellulitis and erysipelas have been well shown by Nunneley. Not only are the local effects precisely the same in the two diseases; the same swelling, tension, infiltration of pus, and formation of gangrenous shreds and sloughs, but the constitutional symptoms, though differing perhaps in degree, present no variety as to character. The results also are identical, there being the same impairment of structure locally, the same tendency to involve parts at a distance, and to the formation of secondary abscesses. So also these two diseases occur in the same constitutions, in the same states of the atmosphere, and in the same situation; one form

of disorder may produce the other, and, lastly, the same treatment is required for both affections.

The *symptoms* of cellular erysipelas are great swelling, tension, and pain in the limb, which feels brawny in some parts, œdematous in others. The skin, which is slightly reddened in patches, has a mottled appearance, and speedily runs into blackish sloughs. The extent to which the disease may spread varies greatly; when once it has set in, it commonly runs rapidly up the whole of a limb, extending also to the sides of the trunk; in other cases, again, its violence appears to be principally expended at a distance from the seat of injury; thus, in a case of a punctured wound of the finger, the diffuse inflammation may principally take place in the extended planes of cellular tissue about the axilla and sides of the chest. It is important to bear in mind that this form of erysipelas sometimes affects the internal planes of cellular tissue. This may happen, for instance, in the fasciæ of the pelvis after lithotomy, or in the anterior mediastinum after operations at the root of the neck. The sloughing often occurs with remarkable rapidity in the course of thirty-six or forty-eight hours, the cellular membrane being broken down into ill-conditioned pus and shreddy sloughs, more especially when the disease has resulted from the inoculation of an animal poison. Death may in such cases occur in two or three days; in other instances, again, several weeks elapse before a fatal result declares itself.

The constitutional symptoms are those of asthenic fever in the most marked degree; a quick and feeble pulse, brown tongue, and muttering delirium, being early concomitants of this affection.

The *diagnosis* of the various forms of erysipelas is generally easily made. From the exanthemata, it is distinguished by the character of the eruption, its limited extent, and usual complication with injury. From inflammation of the veins, or of the absorbents, the diagnosis is not always so easy, more especially as the two conditions frequently co-exist. If it be a vein that is inflamed, the general absence of cutaneous redness, the existence of a hard round cord, and the tenderness along the course of the vessel, are sufficient to establish the diagnosis. In inflammation of the absorbents, the redness will be found not to be uniform, but to consist of a number of small and separate red streaks, running in the direction of the lymphatics, and affecting the glands towards which they course; these two affections, however, erysipelas of the skin and inflammation of the absorbents, are almost invariably conjoined; hence a definite diagnosis is not of much importance.

The *prognosis* in any case of erysipelas depends on a variety of circumstances. The form of the disease influences greatly the result, the cutaneous variety being attended with least danger, the cellular with the most. The traumatic is more dangerous than the idiopathic form. Much, however, depends on other circumstances, such, for instance, as the seat of the affection; that attacking the head and lower limbs being the most dangerous; when the head is affected, encephalitis being apt to ensue. When the legs are extensively implicated, sloughing of the skin and cellular tissue, with denudation of the bones and destruction of the joints, may occur. The disease, in all its forms, is most dangerous at either of the extremes of life. The previous state of health of the patient also influences greatly the result. If the constitution be sound, very extensive mischief may be recovered from; if, on the other hand, it is depressed or broken by want of the necessaries of life, by fatigue, over exertion, or indulgence in stimulants, a very slight amount of disease may probably prove fatal. The most dangerous complication of erysipelas, and one which when it exists almost precludes the hope of recovery, is a granular state of the kidneys with albuminuria. I have never seen any patient laboring under this disease, and attacked with erysipelas, escape with life; the sloughing and suppuration running on unchecked by any treatment that could be adopted. The particular

type the erysipelas may assume, and the occurrence of gastro-intestinal or pulmonary complications, will also seriously affect the result.

Treatment of erysipelas. — The occurrence of erysipelas is best guarded against by attention to hygienic measures, more particularly to proper ventilation with pure air, and the avoidance of over-crowding of patients In hospitals, erysipelas may be produced at will by want of attention in these respects, and it will usually be found that the persistence of erysipelas in certain wards, or even its repeated appearance in certain beds, is owing to some local cause, such as the emanations from a drain, on the removal of which the disease will cease. Scrupulous attention to cleanliness, also, on the part of nurses and dressers should be enforced, and the latter should not be allowed to go straight from the dead-house to the ward without previously washing their hands in some chlorinated solution. When erysipelas has already occurred, its further spread may be prevented by isolating the patients affected, and at once taking active measures to purify the ward from which they have been removed.

The *curative treatment* of erysipelas must always be conducted with reference to the low character of the local inflammation, its tendency to run into suppuration and gangrene, the asthenic type that the constitutional fever readily assumes, and the frequent complication of visceral inflammations of a congestive form. The apparent intensity of the local inflammation must not lead the surgeon into the fatal error of employing an over-active antiphlogistic treatment, more particularly if the disease be epidemic, when it always assumes a low type. In the treatment of this affection, it is especially important to look to the future, and to remember that, if active depletory measures are employed early, with a view of lessening the present disease, it will be at the risk of inducing more extensive sloughing, and perhaps to lower the patient's powers to such a degree, as to prevent his bearing up under the depressing influence of the after-consequences.

In the *treatment of the cutaneous* or simple form of erysipelas, we must in the first instance clear out the stomach and bowels by an ipecacuan emetic followed by a calomel and colocynth pill, and some saline aperient. If the patient be young, robust, and the disease be of a somewhat sthenic character, he should be kept on a mild diet, and have salines, with small doses of antimony, administered every fourth or sixth hour. If the patient be advanced in years, and the disease assume a lower form, no antimony should be given, but effervescing salines, or the acetate of ammonia in camphor mixture, may be administered. If the disease from the first assume a low type, or if it subside into this, the carbonate of ammonia in five or ten grain doses should be added to the preceding mixture, in which the decoction of bark may then be substituted for the camphor julep. In many of the low forms of erysipelas, medicines are not well borne by the patient, the stomach rejecting them, and then I have seen the best possible results follow the free administration of the brandy-and-egg mixture, to which I am in the habit of trusting in the majority of these cases. During the progress of the disease, simple purgatives must be given from time to time. When this form of erysipelas occurs in persons of a gouty habit, it may often be advantageously treated by the administration of colchicum in salines.

The *local treatment* of this, as of every variety of erysipelas, is of equal importance with the constitutional management. Warm applications assiduously continued, especially poppy and chamomile fomentations applied by means of flannels or spongio-piline, afford the greatest possible relief. Cold lotions should never under any circumstances be employed: they not only act injuriously by lessening the vitality of the part, and thus favor local sloughing, but they may chance to cause a retrocession of the disease, and the consequent affection of some internal organ. The local abstraction of blood and of serum from the inflamed part, by the plan introduced by Sir R. Dobson, of rapidly making

with the point of the lancet a large number of small punctures, from a quarter to half an inch deep, is of much value, by lessening the tension and swelling, and consequently diminishing the inflammatory action; a warm fomentation cloth or poultice should be laid over the punctures, so as to encourage bleeding and the escape of serum. Astringent applications to the inflamed surface, such as a strong solution of the nitrate of silver, are recommended by some surgeons. I have seen them pretty extensively employed by the late Dr. A. T. Thomson, but not with any very marked success. A boundary line of nitrate of silver is occasionally drawn around the inflamed part, with the view of checking the extension of the disease. I have often done this, and seen it done by others, but never apparently with any benefit; and have now discontinued the practice as a useless source of irritation. The application of a bandage is occasionally necessary after the disappearance of the erysipelas, in order to remove the œdema that results.

In the *treatment of the cellulo-cutaneous* erysipelas, more energetic constitutional and local means are required than those just described. In the early stage of the disease, our object is to prevent the inflammation running into gangrene of the affected tissues. The fever being at this period commonly of a sthenic character, the more active administration of purgatives, antimonials, or effervescent salines is required. I have never seen a case in which blood-letting is required, and strong antiphlogistics, such as salines, should be given with great caution. The best plan is, perhaps, to give an emetic and purge, to clear out the stomach and bowels, and then to give effervescing salines with carbonate of ammonia, in full doses, gr. x. to gr. xv. As the disease advances, and symptoms of more or less depression come on, it may be necessary to effect that gradual change from a depletory to a stimulating plan of treatment that has already been described in speaking of the management of inflammatory fever; in doing this, the pulse and the tongue must be our guides; as the one becomes feebler and the other browner, so must ammonia, bark, and especially port-wine, and the brandy-and-egg mixture, be administered. In the more advanced stages of the disease, when sloughing and suppuration are fully established, our sole object must be by nourishing diet, and the use of stimulants and tonics, to bear the patient through the depression and subsequent hectic that ensue.

The *local treatment of the cellulo-cutaneous or phlegmonous erysipelas*, must be conducted on essentially the same plan as that of the cutaneous variety, though with the employment of more active means. The part affected must be kept at rest, must be elevated if it be a limb, and have hot chamomile and poppy fomentations assiduously applied, cold being more prejudicial here even than in the last form of the disease; in this way, the swelling and tension may perhaps be removed, and the sloughing of the cellular tissue prevented. In the majority of cases, however, other means will be required to effect this, and with this view none are more efficacious than incisions made into the part; by these an outlet is afforded for the blood and effused serum, which, by distending the vessels and cells of the part, produce strangulation of its tissues and consequent sloughing. This mode of practice, originally introduced by Mr. C. Hutchinson, is generally allowed to be the most effectual means we possess for the prevention of sloughing; hence the incisions should be made early, before there has been time for the tissues to lose their vitality. So soon, indeed, as they have become brawny, indurated and tense, incisions properly made and placed will afford the greatest possible relief to the part and the patient, taking down the tension by their gaping, and the swelling by the exit they afford to blood and serum. Much difference of opinion has existed among surgeons, as to the extent to which incisions should be practised in these cases. Some recommending that one long cut should be made through the inflamed structures; others contending, on the contrary, that a number of small incisions better answer the proposed end. The objections to the long incision are, that so con-

siderable a wound not only inflicts a serious shock upon the system, but that the loss of blood from it is often so great as to be of serious, and even of fatal consequence to the patient, cases having occurred in which life has been lost from this cause, or the hemorrhage only arrested by the ligature of the main artery of the limb,—and also that a single long incision does not relieve tension so effectually as a number of smaller ones. The incisions consequently should be of limited extent, from two to three inches in length: at most they should not extend deeper than into the gelatinous looking subcutaneous cellular tissue, unless it happen that the disease have extended beneath the fascia, when they may also be carried through it. Mr. South recommends that the incisions should be so arranged in fours, as to enclose a diamond-shaped space, and states that in this way the greatest relief is given to the tension of the part: after the incisions have been made, the part should be well poulticed and fomented so as to facilitate the escape of serum. As it is not the object of the surgeon to draw blood in these cases, any undue amount of hemorrhage should be arrested by plugging the wound. After suppuration and sloughing have taken place, as indicated by a boggy feel of the parts, free incision should be made in order to let out pus and sloughs. After this the skin will often be found to be greatly undermined, blue, and thin, with matter bagging in the more dependent parts; if so, egress must be made for it by free counter-openings. During the after-treatment frequent dressing is necessary so as to prevent an accumulation of pus, and the sloughs must be removed as they form. Care should be taken not to destroy any of the vascular connections of the skin with subjacent parts, but in order to get proper cicatrization it will often be found necessary to lay open sinuses, or to divide bridges of unhealthy and blue integument stretching across chasms left by the removal of the gangrenous cellular tissue. If the loss of substance be great, the cicatrix that forms may be weak, imperfect, or so contracted as to occasion great deformity of the limb. In other cases, again, the diseased state of the bones and joints may be such as to call for ultimate amputation, either in consequence of the local deformity and annoyance, or in order to free the constitution from a source of hectic and of irritation. Under all circumstances, the patient's health will usually continue in a feeble and shattered state for a considerable time after recovery from this form of erysipelas, requiring change of air and great attention to habits of life, a nourishing diet, &c.

In the *treatment of the cellular variety* of erysipelas, it is usually necessary to administer stimulants early; ammonia, wine, or brandy may be required from the very first. The surgeon must judge of this by the constitutional condition of the patient, and more particularly by the state of his pulse and tongue. The local treatment is precisely of the same kind as that adopted in phlegmonous erysipelas, except that the incisions require to be made earlier and perhaps more freely; in all other respects, there is no difference between the general management of the two forms of the disease.

SPECIAL FORMS OF EXTERNAL ERYSIPELAS.

Erysipelas of newly-born infants is occasionally met with, more particularly in lying-in hospitals, or in situations where the mother and child are exposed to depressing causes of disease. It usually makes its appearance a few days after the birth, at first about the abdomen and genitals, but spreads rapidly over the whole of the body, being characterized by a dusky redness, which rapidly runs into gangrene of the affected tissues. It has been supposed to arise from inflammation of the umbilical vein, or of the umbilicus itself. It is an extremely fatal affection, owing to the feeble vitality of the child, and presents but few points for treatment; change of air and of nursing, with the administration of

a few drops of Sp. ammonia or brandy from time to time, being all that can be done.

Phlegmonous erysipelas of the head is of very frequent occurrence from slight injuries or operations about the scalp and face, more particularly in elderly people and those of unhealthy constitution. In this form of erysipelas there are two special sources of danger; one is from sloughing of the occipito-frontalis muscle, the other from inflammation of the membranes of the brain. The occipito-frontalis sloughs, in consequence of the pressure to which it is subjected by the swelling of the planes of cellular tissue between which it lies; and the encephalitis occurs apparently by the extension of the inflammation inwards. In the treatment of this affection more active antiphlogistic means, such as venesection, with salines and antimony, are required than in the management of other forms of erysipelas. With the view of preventing sloughing of the muscle, a free crucial incision should be made through the scalp down to the bone, the head, of course, having been shaved at the onset of the disease.

Bagging of matter must be prevented by free counter-openings, and the application of pads and bandage wherever it is likely to occur. However much the scalp may be undermined, or the bones of the cranium exposed, adhesion usually takes place, and the vitality of the parts is preserved.

Erysipelas of the scrotum, the "inflammatory œdema," so well described by Liston, is of frequent occurrence, as the result of wounds, ulcers, and other sources of irritation in this neighborhood. In this affection the scrotum swells to a large size, being uniformly red, but with a semi-transparent glossy appearance, pitting readily on pressure, and feeling somewhat soft and doughy between the fingers; the integuments of the penis are also greatly swollen and œdematous, and sometimes the inflammation extends to the cellular tissue of the cord. The chief characteristic of this form of erysipelas is its tendency to run into slough without any previous brawny or tense condition of the parts, the dartos becoming so distended with sero-plastic fluid that the circulation through it is arrested and its tissue loses its vitality. When an incision is made into it in this condition it scarcely bleeds, and the sides of the wound present a yellowish-white gelatinous appearance. The treatment of erysipelas of the scrotum is simple; it consists in making a free incision about four inches in length from behind forwards on either side of the septum, taking care, of course, not to go so deep as to wound the testes; the part must then be supported on a pillow, and well poulticed and fomented. If this incision be not made at once, a great part, or even the whole of the scrotum may slough away, leaving the testes and cord bare; under these unpleasant circumstances, however, the parts will often with great rapidity cover themselves with a new integument. The œdema of the penis usually subsides of itself, or by making a few punctures in it; should its integuments, however, threaten to slough, a free incision must be made into it, or the prepuce be slit up.

Erysipelas of the pudenda is occasionally met with in ill-fed unhealthy children in whom cleanliness is neglected. The parts become of a dusky or livid red, swell considerably, and quickly run into gangrene, which spreads up the abdomen or down the nates. It may prove fatal by inducing peritonitis or exhaustion. In the treatment, ammonia, bark, and the chlorate of potass, with good nourishment, and a little wine, are the principal means to be employed, at the same time that yeast or chlorinated poultices are applied locally.

Erysipelas of the fingers, or as it is commonly called "*whitlow*," is a frequent affection in old and in young people, either occurring spontaneously in cachectic constitutions, or arising from the irritation produced by scratches, punctures, or the inoculation of the part with poisonous or putrescent matters. It is most common in the spring of the year, when, indeed, at times it appears to be epidemic, large numbers of persons suffering from it without any very apparent local cause.

That whitlow is truly an erysipelatous affection of the fingers appears to be the case for the following reasons: — 1stly. Because the causes, whether of season, infection, or local irritation, appear to be the same in both affections. 2dly. The constitutional disturbance is always very severe for so slight a disease, and assumes the same character of speedy depression that we observe in erysipelas. 3dly. The inflammation of the affected finger is invariably diffuse, never being bounded by adhesion, but always tending to terminate in suppuration and sloughing. And, lastly, so soon as the disease spreads beyond the affected finger, or to the back of the hand, it assumes a distinctly erysipelatous appearance and character.

The inflammation of whitlow is in many cases confined to the pulp of the finger, commencing in the dense cellulo-fibrous tissue forming this, and often arising from a very slight injury, as the prick of a pin or splinter, but not unfrequently without any traumatic cause. The part becomes extremely painful, hard, red, and swollen; it then suppurates to a limited extent, with some sloughing of the cellular tissue. In many cases the ungual phalanx, which is imbedded in the cellulo-fibrous digital pulp, necroses when this sloughs; there is usually some inflammation of the lymphatics of the arm accompanying this affection, and not unfrequently a good deal of constitutional fever and irritation.

In the more severe cases of whitlow, the inflammation, which is of an excessively painful character, owing probably to the tension of the parts, extends to the sheaths of the tendons, and then constitutes an affection that is fraught with danger to the utility of the finger or hand. In these cases the whole finger swells considerably, becomes red and tense, with much throbbing and shooting pain; the inflammation rapidly extends to the dorsum of the hand, which becomes puffy, red, and swollen, presenting the ordinary characters of erysipelas. Although the palm be greatly swollen, it usually preserves its natural color, or becomes of a dull white, owing to the greater thickness of the cuticle in this situation. Pus rapidly forms, both in the finger and hand, and finding its way into the sheaths of the tendons, will spread up the forearm under the annular ligament. There is usually no fluctuation to be felt in the finger, even though pus may have formed, but in other parts of the hand it may readily be detected in the usual way. In these cases there is always much sloughing conjoined with the suppuration, the cellular tissue of the finger and hand, the tendons or their sheaths, and the palmar fascia, being all more or less implicated. In many cases the joints of the fingers are destroyed, and the phalanges necrose, or if this do not happen, the tissues of the part may be so matted together as the result of sloughing and suppuration, that rigid and contracted fingers, or a stiff and comparatively useless condition of the hand, may be permanently left.

In the *treatment* of this affection, the patient should be well purged, and kept upon a strictly antiphlogistic plan during the early stages. At the same time the inflamed finger should be freely leeched, and then alternately poulticed and soaked in very hot water for twenty-four or forty-eight hours, being kept during the whole of this time in an elevated position. In this way the inflammation may be sometimes cut short at its onset; should it, however, continue to progress, the finger becoming hard, with much throbbing, a free longitudinal incision must at once be made along either side of it, so as to relieve tension and prevent sloughing; this, though a painful procedure, should never be omitted, on account of the importance of the preservation of the full utility of the part. The incision is best made from the proximal towards the distal end of the finger, so that if the patient make an attempt to withdraw the hand during the operation, he will rather facilitate the cut being made than otherwise. In making these incisions, however, the sheaths of the tendons should, if possible, be avoided; if these be opened, the tendons will probably slough,

and the finger be left in a permanently extended and rigid state. The finger must then be well soaked in hot water, and poulticed. In this way the inflammation may be arrested, and sloughing happily prevented; should, however, matter have formed, this must be let out as it accumulates, and all hardened and sodden cuticle peeled from the part. After the opening has been made, and any sloughs that have formed come away, it not unfrequently happens that a large and fungoid granulating mass sprouts up; this will, however, gradually subside, as the swelling of the finger goes down and the inflammation abates. If the nail become loosened, it had better be removed, as it may otherwise keep up irritation; it must not, however, be torn off if adherent, but then merely scraped and cut away so far as loose. When the whole of a finger is affected, the hand should be placed on a pasteboard splint so soon as the inflammation has been somewhat subdued, lest contraction of the affected finger ensue, which may eventually extend to the neighboring ones.

When the joints are implicated, destruction of the cartilages commonly ensues, but yet, by position, and rest on a splint, a tolerably useful, though stiffened finger may be left. When the bones are implicated, some operative procedure usually becomes eventually necessary. If the ungual phalanx alone be necrosed, it may be excised through an incision on the palmar side of the finger, the pulp and nail being left; in this way I have often preserved a finger that must otherwise have been removed. Amputation of the finger of the metacarpo-phalangeal articulation will usually be required when the second or proximal phalanges are involved, though here, partial operations by cutting and scraping away the diseased bone, may sometimes be usefully done. During the later stages of these affections, tonics, good diet, and stimulants will be required for the re-establishment of the health.

INTERNAL ERYSIPELAS.

By internal erysipelas is meant those forms of diffuse inflammation which affect the mucous or serous surfaces, or the lining membrane of arteries, veins, lymphatics.

The mucous surface that is chiefly affected by this disease is that covering the fauces, the pharynx, or the larynx.

Erysipelas of the fauces may occur in consequence of the disease spreading from the head and face to these parts, or it may commence as a primary affection, occurring perhaps at the same time that the rash appears on the cutaneous surface on some distant part of the body. When the fauces are erysipelatous, they present a bright crimson or scarlet color, with some swelling and thickening of the soft palate and uvula; there is also most commonly some huskiness or complete loss of voice, and occasionally some croupy symptoms. At the same time there is a good deal of low constitutional fever, with a pungent, hot skin, and quick pulse. This form of erysipelas is of a peculiarly contagious character, and occurs not unfrequently in the attendants of those who are laboring under some of the other varieties of the disease; of this I have seen numerous instances. In many cases, also, it is epidemic, spreading through a house, and affecting almost every inmate. In the treatment of this affection, the best results are obtained by sponging the inflamed parts freely with a strong solution of the nitrate of silver; and, if there be much constitutional depression, administering full doses of ammonia, with camphor or bark. Should the disease go on to sloughing, constituting some of the forms of "putrid sore throat," which not unfrequently happens, the mineral acids and bark, with chlorinated port-wine gargles, and the brandy-and-egg mixture for support, will be found most useful. In many cases, this disease continues limited to the palate and fauces; but in others it extends either upwards or downwards. It may extend upwards through the nares, out of the nostrils, and thus spread over the face

and head. It may extend downwards, affecting the gastro-intestinal membrane, or more frequently implicating the larynx.

Erysipelatous Laryngitis, as described by Ryland, Budd, and others, is an extremely dangerous affection. The inflammation in these cases commencing in the fauces, rapidly spreads to the mucous membrane and loose submucous cellular tissue, external to, and within the larynx, giving rise to extensive œdematous infiltration of these parts with sero-plastic fluid, which, by obstructing the rima glottidis, may readily suffocate the patient. In consequence of this special tendency to œdema, the disease has by many writers been termed "*œdematous laryngitis.*" After death, in these cases, the submucous cellular tissue of the fauces, that about the base and frœna of the epiglottis, and especially that which covers the posterior part of the larynx, will be found to be distended with serum or a sero-puriform fluid. This infiltration occupies the rima of the glottis, and extending into the interior of the larynx, gives rise to such swelling that its cavity is nearly obliterated. Great as the swelling may be, however, in all these parts, it never spreads below the true vocal chords. This fact, which is of considerable importance, is owing to the mucous membrane coming closely in contact with, and being adherent to, the fibrous tissue of which these are composed, without the intervention of any submucous cellular tissue. The progress of this œdematous inflammation of the mucous membrane, and loose submucous tissue in these situations, is often of an amazingly rapid character, the swelling being sufficient to induce suffocation at the end of thirty-six or forty-eight hours, or even sooner. If the patient be not carried off in this way, there will be a great tendency to suppuration and sloughing of the affected tissues, leading perhaps eventually to death from absorption of pus, and low constitutional fever.

The *symptoms* of this affection are strongly marked: the patient, after being attacked with erysipelas of the fauces, attended by some difficulty and pain in deglutition, with huskiness of the voice, is seized with more or less difficulty in breathing, coughs hoarsely and with a croupy sound, and complains of tenderness under the angles of the jaw and about the larynx. The difficulty in breathing increases, and may speedily threaten the life of the patient, giving rise to intense fits of dyspnœa, in one of which he will probably be suddenly carried off. On examining the throat from the interior of the mouth, the fauces will not only be observed to be much and duskily reddened, but by depressing the tongue the epiglottis can be felt, and perhaps seen, to be rigid and erect.

In the *treatment* of this affection local means are of the first importance. The tongue having been well depressed, the posterior part of the larynx, the epiglottis and its frœna must be well scarified by means of a hernia knife, with which this operation may be most readily and safely done. The patient should then be directed to inhale the steam of hot water, and a large number of leeches may be applied under either angle of the jaw, to be followed by large and hot poultices; at the same time, the bowels must be kept well opened, and the patient treated antiphlogistically or otherwise, according to the condition of the constitutional fever. Most frequently, in these cases, I have found antimonials of great service in the early stages, followed at a later period by support and stimulants. A few hours after the engorged tissues have been unloaded by scarification, the fauces, pharynx, and upper part of the larynx should be well sponged out with a strong solution of the nitrate of silver (ʒi. to ʒi.) which must be applied freely, coagulating the mucus, and taking down the increased vascular action. If, understanding the employment of these means, the dyspnœa increase, the face becoming pale, livid, and bedewed with a clammy perspiration, it will be necessary, in order to save the patient from impending suffocation, to open the windpipe. In doing this I prefer the operation of laryngotomy, for reasons that will be mentioned when I come to speak of the diseases and operations of the air-passages. In order that this operation should be successful, it must not,

however, be too long delayed, and should not be looked upon as a last resource; if done in time, and time in these cases is most precious owing to the rapid progress of the disease, the patient's life may probably be saved; but if deferred too long, congestion of the lungs will have come on, the blood will cease to be properly arterialized, and the patient will sink from a slow asphyxia, even though air be at last freely admitted. If the patient survive to the stage of sloughing, chlorinated gargles and support must be our chief reliance.

Erysipelas of the serous membranes is of common occurrence in surgical practice, being frequently met with in the arachnoid and peritoneum. These, like all other serous membranes, are liable to two distinct forms of inflammation, one, which is of a sthenic character, having a tendency to the formation of plastic lymph; the other, which is of a diffuse or erysipeloid form, being always accompanied by the exudation of a plastic unorganizable fibrine.

Erysipelatous or "*diffuse*" *arachnitis* commonly occurs as a consequence of injuries of the head and erysipelas of the scalp. In these cases there is usually a flushed countenance, bright staring eyes, low muttering delirium, alternating with a comatose condition, and rapidly terminating in death; the constitutional symptoms are those of low irritative fever. On examination after death, the arachnoid and pia mater will be found greatly injected with blood, forming a close red net-work of vessels over the surface of the brain, the substance of which is usually somewhat injected, the ventricles being distended with a reddish-colored serum. If examined at a later period in the disease than this, the inflamed arachnoid will be found to be covered with a layer of opaque puriform lymph of a greenish-yellow color and slimy consistence.

Erysipelatous or "*diffuse*" *peritonitis* is not unfrequently met with in aged and cachectic subjects after the operation for hernia, or as a consequence of various diseases and injuries of the pelvic or abdominal organs. In this form of peritonitis, the symptoms are often of a latent character, the disease being chiefly indicated by obscure pain diffused over the abdomen, with tenderness on pressure, and an anxious depressed countenance, a hot skin, and a small and rather hard pulse. On examination after death, the subperitoneal cellular tissue will be found injected, the peritoneum opaque in parts, covered with filmy patches of greyish lymph, and usually containing a largish quantity of opaque dirty-looking turbid fluid, mixed with shreds and flocculi of lymph. This, though closely resembling pus in appearance, is serum with lymph intermixed, and is of a peculiarly acid, acrid, and irritating character. It is this form of peritonitis that is so dangerous to dissectors; inoculations of the fingers with any of this fluid being often productive of the most serious and even fatal consequences.

The erysipelatous inflammation of the lining membranes of the vascular system, will be fully discussed when we come to consider diseases of these parts.

CHAPTER XXVIII.

PURULENT INFECTION, OR PYEMIA.

By *pyemia* is meant a dangerous and often fatal affection, supposed to depend upon the admixture of pus with the blood. This disease is closely allied to some of the lowest and worst forms of erysipelas, with which indeed it is commonly associated, and to which it presents great similarity in its causes, symptoms, and effects.

Like erysipelas, pyemia commonly occurs at those seasons of the year, and under those atmospheric conditions in which diseases of a low type are prevalent, frequently as the result of overcrowding in hospitals, and it is in unhealthy and cachectic constitutions that it usually manifests itself. Though it is least frequently met with during the earlier periods of life, yet it may make its appearance at any age, and I have seen very young children carried off by it.

Pyemia is never, I believe, an idiopathic or primary affection, but either occurs subsequently to an injury or wound of some kind by which inflammation is excited, which has in most cases reached the stage of suppuration before the pyemic symptoms come on; or in connection with some low form of suppurative inflammation. Thus we often see boils, carbuncles, diffused abscess, erysipelas of the skin, or erysipeloid inflammation of the veins or absorbents precede its occurrence. Wounds of veins, of bones, and of joints, are the injuries that are especially apt to be followed by this disease; and in the puerperal state it is often met with, probably as the result of uterine phlebitis.

Pyemia is characterized specially by two series of phenomena. The first is a state of great depression of the powers of the system; the second, the formation of abscesses in various parts of the body. The symptoms are as follow:— The patient is seized with rigors, usually of a very severe and continuous character, but occasionally short and transient, sometimes occurring irregularly, at others being repeated almost periodically twice or thrice in the twenty-four hours, for some days in succession; in some cases these rigors are not attended by any sensation of cold, but in others they are, and then alternating with much febrile disturbance resemble very closely an ague fit; any open wound that may exist at this time usually becomes foul, sloughy, and ceases to secrete pus, though I have seen it continue healthily granulating throughout the disease. The skin is hot, and has a burning pungent feel. The breath has that peculiar sweetish, saccharine or fermentative smell that is commonly noticed in all febrile diseases of a low type; this odor of the breath, and indeed of the body generally, often occurs early in the disease, and must then be taken as a very unfavorable sign. The secretions are arrested, the pulse is quick and feeble, the face is usually pale, with a very anxious drawn look, but sometimes flushed and the eyes bright; there is hebetude and dulness of mind, with slight nocturnal delirium, but perfect consciousness on being spoken to; about this period, patches of erratic erysipelas frequently make their appearance on the surface, and the skin assumes a dull, sallow, and earthy, or a bright yellow, icteric tint, which may extend even to the conjunctivæ. The symptoms now indicate an extreme depression of the vital powers, the pulse becoming small and fluttering, the tongue brown, with sordes about the teeth, and low delirium; usually from the sixth to the tenth day, but sometimes earlier, diffuse suppuration begins to take place in different tissues, joints, and organs. This may occur in the viscera without occasioning any material pain; if seated in the cellular tissue, or in the substance of muscles, there is much doughy swelling, with some redness; if in the joints, the swelling is often considerable, the pain usually intense and of a very superficial and cutaneous character, the patient screaming loud with the agony he suffers. These pains, which are chiefly seated in the knees, ankles, hips, and shoulders, often simulate rheumatism very closely.

The progress of the disease is usually from bad to worse, sometimes rapidly, but at other times not uninterruptedly so, there being remissions and apparent, though not real, improvement. The patient rapidly wastes, the body becoming shrunken, the muscles soft, and the skin loose and pendulous; great debility also sets in. The abdomen becomes tympanitic, diarrhœa or profuse sweats come on; pneumonia or pleuritic effusions declare themselves; delirium, from which the patient is easily roused, alternates with sopor, and at last he sinks from exhaustion. Death usually takes place about the tenth or twelfth day,

though it may occur as early as the fourth, or the patient may linger on for six or seven weeks.

In other cases pyemia occurs in a very insidious manner, without rigors, but merely with prostration, and some low fever of an intermittent kind; after a time the skin assumes a yellow tint, as do the conjunctivæ. The urine is very high-colored, and perhaps the peculiar odor in the breath or body may be noticed; but the patient continues in a quiet state, his wound clean, and suppurating healthily. He gets, however, symptoms of low pneumonia or pleurisy, with, perhaps, pain and fulness in one joint, where abscess forms, and then the disease fully declares itself.

The formation of numerous purulent deposits, "secondary or metastatic abscesses," as they are often termed, is one of the most marked features of pyemia. These abscesses usually contain a somewhat thin and oily-looking pus; at other times, however, it is thick and laudable. The more oily-looking fluid, though opaque and yellow, and closely resembling true pus, will, on microscopic examination, be found to differ from this in the absence of the true nucleated pus-corpuscle, though it contains an immense number of granular cells (figs. 49 and 50.) After removal it often forms a firm fibrinous coagulum. These purulent collections vary greatly in size and in situation, they are found in the viscera, in the cellular and muscular structures, in the serous membranes, and in the joints.

Pyemic abscesses differ from ordinary purulent collections, not only in the peculiar character of the pus that they contain, but more particularly in the rapidity with which they form, a few days commonly sufficing for them to attain a large size. So, also, their very widely-spread character, and the insidious manner in which they occur, — the tissues, as it were, breaking down without any inflammation, — constitute the distinguishing features of these collections.

The visceral abscesses vary in size from a pin's head to a walnut; in many cases the organs affected are studded with them. These collections are most frequently met with in the lungs, being seated on the surface of the organs, or in the interlobular fissures, next, in the liver, and then, in the spleen; they are usually surrounded by a darkly-inflamed and condensed layer of tissue, which forms an imperfect wall to the collection. They may occur in other organs; thus, my friend, and late house-surgeon, Mr. Gamgee, has on several occasions observed them in the prostate.

When the pus is infiltrated into the cellular tissue and muscles of the limbs and trunk, it will form immense diffuse collections of a thin and serous matter, commonly mixed with shreds of the cellular membrane of the part. These collections are most frequently met with, perhaps, in the axilla, down the flank and about the back, in the iliac fossa, thigh or calf, and may either be confined to the subcutaneous, or extend to the deep intermuscular cellular planes in these regions; or may even form in the muscular substance itself, being diffused between the fasciculi which are softened and disintegrated. Most commonly the presence of these collections is indicated by patches of cutaneous or erratic erysipelas, and by a doughy, œdematous, and boggy state of the superjacent integuments.

Accumulations of pus in the serous and synovial membranes are common in this disease; the arachnoid, the pleura, or the peritoneum may all be affected in this way. More frequently, however, some of the joints, especially the knees and shoulders, become filled with a thin, yellow, purulent liquid. These arthritic abscesses are usually indicated by the occurrence of intense pain, often of a cutaneous or superficial character, with fluctuation and swelling in the articulation affected. It often happens, however, that large accumulations of pus form suddenly in joints, without having been preceded by pain or any other sign of mischief; in these cases the interior of the joint, though filled with pus, will be found to be tolerably healthy, there being no erosion of cartilage or destruc-

tion of ligament, but merely some inflammatory injection of the synovial membrane.

Not only are the appearances just mentioned commonly met with in cases of death from pyemia, but we find the viscera, more particularly the brain and lungs inflamed, and, not unfrequently, a diffused erysipelatous redness of some membranous surface, as of the arachnoid or gastro-intestinal mucous membrane.

The *diagnosis of pyemia* is not always easy in the earlier stages, when the rigors, depression, and other signs of constitutional disturbance may be looked upon as common to other intercurrent diseases. As the affection declares itself, however, the continuance and severity of the rigors, the extreme want of power, the icteric tinge of the skin, the peculiar faint and sickly odor of the breath, and the occurrence of metastatic and visceral abscesses, indicate the true nature of the attack.

The question necessarily arises, to what are the symptoms and destructive effects of pyemia due? There can be little doubt that they are owing to the alterations that take place in the blood itself. It is only in this way that the remarkable diffusion of the disease, the variety of tissues affected, and the widespread tendency to suppuration that characterizes it can be explained. That the blood undergoes important changes in this disease is unquestionable; it is thin, dark-colored, and, after having been drawn from the body, forms a loose, spongy coagulum, from which a moderate quantity of rather turbid or milky-looking serum separates. On examination under the microscope it will be found that, besides the ordinary red corpuscles, the blood contains, often in large quantities, corpuscles, that in some cases closely resemble the ordinary white ones of the healthy blood, and at others present such exact similitude to the pus-cell, that the most practised eye fails in detecting a difference. These corpuscles may be few in number, and at other times so abundant that they occupy the field of the microscope to the exclusion of the red. The existence of these corpuscles in the blood, which I believe will invariably be found on careful examination, more especially in that taken from the larger veins, constitutes apparently one, if not the essential element of the disease. That they are true pus-corpuscles, in many cases, would seem to be probable from their microscopic appearances; in others again, they do not present the characters of the true pus-cell, differing from it in the shape, or in the absence of a nucleus, and in their more irregular outline; resembling indeed more closely the white corpuscles, or some of the ill-developed granulation or exudation-cells that are met with in cold or lymphatic abscesses occurring in cachetic constitutions. Whatever differences of appearance these corpuscles may present, they can best be compared to those pus-cells that are found in many unhealthy abscesses, and more especially in the diffuse purulent collections occurring in the cellular tissue or the joints in this very disease; and like these I think we must look upon them as products of inflammation, though perhaps of a low and aplastic form.

The question that next presents itself is, how do these corpuscles find their way into the blood? and how do the other changes that occur in the physical characters of this fluid take place? By some surgeons it has been supposed that the pus is actually and bodily absorbed from the surface of the suppurating wound, and so admixed with the blood. This explanation, however, is not tenable, as there is not only no proof, but no reason to believe in the possibility of the absorption of a pus-corpuscle in its state of integrity from the surface of a wound. Then, again, it has been supposed that the pus having trickled, or in some other way found an entrance into the open mouth of a divided vein, as upon the surface of a stump or in a sawn bone, has gained access to the general circulation. But it is difficult to understand how pus can possibly become admixed with the general current of the blood in this way; for if the vein be sufficiently open to allow of the entry of one fluid, it would certainly be so to admit of the escape of the other. The theory that has the most advocates at

the present day, is, that the pus enters the circulation as a consequence of phlebitis, being formed directly by the lining membrane of an inflamed vein, and thus poured at the moment of its evolution into the current of blood passing along the vessel. This dependence of pyemia on suppurative phlebitis, more especially of a diffuse character, has been strongly advocated by Hunter, Arnott, Bérard, and others, and affords an easy solution to the difficulty, and has acquired considerable weight from the fact that in many cases these affections are found co-existing. I am by no means prepared to deny that the pus does in all probability in very many cases become directly admixed with the blood in this way, and that suppurative phlebitis is consequently in these instances the cause of the pyemic symptoms. This explanation would indeed be conclusive, if it could be shown that phlebitis was the only, or even the most frequent form of diffuse inflammation occurring in connection with pyemia, and that it always took place as a precursor and concomitant of the blood affection. But this I believe not to be the case. I have had opportunities of examining the bodies of a considerable number of patients who have died of pyemia, and I have certainly often found evidence of other diffuse inflammations as well as of phlebitis; and in some cases no inflammation of the veins could be detected on the most careful investigation specially directed to this point; and hence I cannot but come to the conclusion that pyemia, though frequently co-existing with, may occur independently of suppurative phlebitis, and cannot in all cases be necessarily considered a consequence of that disease.

Tessier maintains that pyemia is always independent of phlebitis, being a primary blood disease. The doctrine, however, is irreconcilable with the established fact, as pointed out by Sedillot, that the injection of pus into the blood produces a disease identical with pyemia; that this affection is always preceded by local inflammation, and usually by suppuration, and that a distinct connection has been pointed out by Hunter, Arnott, and Bérard between suppurative phlebitis and pyemia. Besides this, the presence of cells in the blood resembling the pus-corpuscle admits of proof.

In the very excellent essay published by Mr. Henry Lee on this subject, that surgeon expresses his opinion that the introduction of pus into the system from an inflamed or injured vein is rarely the first step in purulent infection, but must have been preceded by some change that has taken place in the blood, by which its coagulating power has been impaired. Mr. Lee's views are supported by a number of ingenious experiments.

How are we to account for the changes that the blood undergoes, and which whether resulting from suppurative phlebitis or not, are the essential causes of the pyemic symptoms?

The explanation that I would suggest as to the cause of the presence of the true or imperfectly formed pus-cell in the blood in these cases is the following. For pyemia to occur, I believe it to be invariably and absolutely necessary that a local inflammation previously exist in some part of the body. This may either be external or internal; it may be limited in size to that of a boil, or it may be as extensive as the surface of a sloughy stump. In all cases this inflammation is of, or tends to assume, a suppurative character; and in all, the constitution is broken, and of that kind in which the corpuscular or aplastic lymph commonly forms. It is not difficult to suppose that the blood in circulating through the part so diseased, instead of undergoing those peculiar changes that are impressed upon it in its passage through tissues that are sthenically inflamed, and of which the most remarkable is the formation in it of a large quantity of plastic filamentous fibrine, — as evidenced by the hard firm coagulum, by the formation of the buffy coat, and by the tendency to the deposition of coagulable lymph, as well as by the occurrence of constitutional fever of the sthenic type, — may undergo alterations in composition, of equal extent, though of a far different kind. It appears not improbable that

the fibrine formed in the blood in these low inflammations, occurring in broken constitutions and at unhealthy seasons, may assume that corpuscular or aplastic character which we have already seen to be the invariable result of these conditions, and that the corpuscles, which are met with intermixed in greater or lesser quantity with the blood in pyemia, and that bear a sufficiently close resemblance to granulation or exudation-cells, to all the various forms of the unhealthy, and occasionally to the typical variety of the pus-corpuscle, are in reality the conditions under which superfibrination of the blood with corpuscular lymph would necessarily show itself. That, consequently, instead of being formed from without, and absorbed or poured into the blood, they are actually generated in that fluid itself during its passage through the unhealthy-inflamed tissue, not however by any conversion of the blood-globule into a lymph or pus-cell, but as a consequence of those changes which we know, by their effects, to be impressed upon the blood by circulation through inflamed tissues, but with the precise nature of which we are still unacquainted. It is also by these blood-changes in pyemia that we may account for the remarkable constitutional depression that exists; for if, as there is every reason to believe, the admixture of plastic fibrine with the blood will occasion sthenic inflammatory fever, the formation of aplastic exudation-matter in that fluid may occasion a correspondingly low type of constitutional disturbance.

As the blood circulates through an inflamed vein, not only would those changes take place in it that occur in its passage through other tissues, but it would thus become mechanically mixed with the pus and exudation-matters poured out in large quantity by the lining membrane of the vessel; and hence we may explain the greater liability to the occurrence of pyemia after or in combination with suppurative phlebitis, than in connection with any other inflammatory affection elsewhere situated.

When once these corpuscles are admixed with the blood, it is probable that abscess is a necessary result from their mechanically occluding the capillaries, as Cruveilhier long ago showed experimentally to be the case. The pus-cells, being larger than the blood-corpuscles, become arrested in the capillaries of organs, and thus constitute points of irritation, around which inflammation is set up, and in which suppurative action takes place; these changes being first induced in those organs, the capillaries of which are of a very small calibre, as in the lungs.

The tendency to suppuration of joints, and to the formation of diffused collections in the muscles and cellular tissue, can scarcely, however, be accounted for in this way, and are probably dependent on other causes, amongst which the low crasis of the blood is the most powerful.

The *treatment of pyemia* is of the most unsatisfactory character. It doubtless happens that patients occasionally recover from this disease, but such a result must be looked upon as a happy exception to its commonly fatal termination. The only plan of treatment that holds out any reasonable hope of success, appears to me to be the stimulating and tonic one. I have certainly seen service done, in some cases, and indeed recovery effected, by the administration of large doses of quinine, as much as five grains being given every third or fourth hour, with the best effect. A very serious case of pyemia, lately under my care at the hospital, occurring after amputation of the arm, and accompanied not only by all the symptoms of that disease in a very marked manner, but by pleuritic effusion, swelling and tenderness over one hip, and secondary hemorrhage from the stump, got well by perseverance in the tonic and stimulating plan of treatment. If the depression is very great, the carbonate of ammonia in ten or fifteen grain doses may be given from time to time; such nourishment as the patient will take, with a liberal allowance of dietetic stimulants, being also administered.

In the case of a superficial vein being inflamed, it has been recommended by

some of the French surgeons, as Bonnet, Bérard, and Laugier, that the actual cautery should be freely applied along the course of the vessel, and they state that the best results have followed this practice. As abscesses form, they must be freely opened; and the diffuse and purulent collections forming in the cellular tissue must be evacuated.

CHAPTER XXIX.

TUMORS.[1]

THE frequency with which tumors fall under the observation of the surgeon, the great variety in their characters, and their important relations, local as well as constitutional, render their consideration one of great moment. According to Hunter, a tumor is "a circumscribed substance produced by disease, and different in its nature and consistence from the surrounding parts." This definition, though not perhaps accurately correct in some forms of tumor, which do not differ in their nature from neighboring parts, is yet substantially a good and convenient one. By a tumor may also be said to be meant a circumscribed mass, growing in some tissue or organ of the body, and dependent on a morbid excess or deviation of the nutrition of the part. The tumor thus formed increases in size by an inherent force of its own, irrespective of the growth of the rest of the system, and differs essentially from the normal structure and appearance of the part of the body in which it grows. In order to constitute a tumor, it is necessary that the normal form of the part be widely departed from — a mere increase in its size, so long as it preserves its usual shape, being scarcely considered in this light. Thus, if the tibia be uniformly enlarged to double its natural size, it would be said to constitute a hypertrophy, not a tumor; but, if a comparatively small rounded mass of bone project directly forwards from its tuberosity, it would be said to be a tumor, and not a mere hypertrophy.

Surgeons divide tumors into two great classes, the *non-malignant* and the *malignant*. This division, though practically convenient, is not scientifically exact. Recent researches have shown that, although some tumors, as the cancers, are always and essentially malignant, and others as uniformly benign, as lipomas and some cysts, yet that many others that are usually innocent may, under certain conditions, at present unknown, take on a truly malignant action: this has led to the establishment of an intermediate group, that may be termed the *semi-malignant*.

The *non-malignant, innocent*, or *benign* tumors are strictly local. They resemble more or less completely the normal textures of a part, and hence are very commonly, though not perhaps with strict propriety, termed *homomorphous*. They usually grow slowly, are more or less distinctly circumscribed, being often enclosed in a cyst, and have no tendency to involve neighboring structures in their own growth; any change that they induce in contiguous parts being not by the degeneration or conversion of these into their own structures, but simply by the effects produced by their size and pressure displacing or atrophying them. They are sometimes single, but not unfrequently multiple, developing either simultaneously or successively; but if in the latter

[1] In Paget's Lectures on Surgical Pathology, vol. ii. will be found the most philosophical account of tumors in this or any other language.

mode, without any connection with preceding growths. If removed by operation, they do not return; but if left to the natural processes of nature, they may slowly attain a great size, remain stationary, and at last atrophy, decay, or necrose.

The essentially *Malignant* tumors differ widely from those last described. They cannot be considered as strictly local diseases, as in many cases they result primarily from a constitutional vice, or if local in the first instance, have a tendency rapidly to affect the constitution. They are essentially characterized by an extreme vegetative luxuriance and an exuberant vitality. They proceed from a germ which, in a manner at present unknown to us, is formed in some organ or tissue, where it develops by an inherent force of its own, irrespective of neighboring parts, producing a mass which differs entirely in structure and appearance from anything observed in the normal condition of the body; and hence, not unfrequently called *heteromorphous*. This term, however, cannot be considered strictly accurate, inasmuch as the microscopic elements of which this mass are composed have their several analogues in the normal structures of the body. This mass, which may either be infiltrated in the tissues, or localized by being confined to a cyst, increases quickly in size; not uncommonly indeed the rapidity of the growth may be taken as a measure of the malignancy of the tumor. As it increases in size, it tends to implicate the neighboring structures in its own growth, and to affect distant organs through the medium of the lymphatics or the blood; if removed by operation it has a great tendency, under certain conditions, local and constitutional, to return in its original site or elsewhere, though it does not necessarily do so. If left to its own development, a malignant tumor will inevitably soften, necrose, and ulcerate, often with much pain, profuse hemorrhage, and the induction of a peculiar state of constitutional cachexy, which speedily and necessarily terminates in death.

Interposed between these two classes, we find a third group that partakes more or less of the characters of both; these may be termed *semi-malignant* tumors.

The malignant tumors are usually of a cancerous nature, but "*malignant*" and "*cancerous*" are not synonymous. Every malignant tumor is not a cancer, though every cancer is a malignant growth. Some tumors are malignant in their course, though they present neither to the naked eye nor to the microscope any cancer structure or any heteromorphous constituent, but are strictly homomorphous, being fibrous, fibro-plastic, or cartilaginous. In most instances such tumors are benign in their course as well as in their structure, but in other cases, and without any evident cause, they affect a truly malignant action; thus the term malignant would have reference rather to the course adopted by the tumor than to the structure of the growth itself, for a tumor may be anatomically benign, but functionally malignant. Paget has very fully described varieties of the fibro-plastic as well as of the fibrous and cartilaginous tumor, which though preserving throughout a uniform character, microscopical and otherwise, that is not considered malignant, have nevertheless destroyed the patient by repeated recurrence after removal, and by ultimate ulceration, sloughing, and contamination of neighboring tissues, or even of distant organs through the medium of the circulation. He makes the important observation that in different persons and under different conditions the same disease may pursue very opposite courses, appearing in some to be of an innocent, in others of a malignant type; and he makes the very interesting practical remark, which agrees entirely with the result of my own observation, that the children of cancerous parents may be the subject of tumors apparently innocent in structure, but certainly resembling malignant growths in the rapidity of their progress, their liability to ulcerate and to bleed, and their great disposition to return after removal.

Innocent and malignant tumors are occasionally met with in the same person, four or five different kinds of growth even occurring in one individual. I have

seen in one patient a scirrhous breast, an enchondromatous tumor of the leg, and atheromatous cyst on the back, with scrofulous glands in the neck. Malignant and benign formations may even be found in the same mass; thus encephaloid and enchondroma are not unfrequently met with together in the testis. This, however, must not be taken as any evidence of the possibility of the conversion of one into the other, and indeed there is no proof that a non-malignant can be converted under any circumstances into a malignant tumor of a different type; a fibrous growth may degenerate and assume all the character of malignancy, at last destroying the patient, but there is no evidence that it can ever be changed into a cancerous mass. A malignant tumor may, however, be deposited on the site of a non-malignant growth that has been removed: thus I have seen a scirrhous nodule deposited in the cicatrix left after the removal of a cystic sarcoma of the breast.

Beside these various forms of tumors, others are met with of a constitutional and specific character, such as those that occur in scrofula and syphilis.

NON-MALIGNANT, OR INNOCENT TUMORS.

The *innocent tumors* may, I think, be most conveniently arranged in three great classes.

1st. Encysted tumors of all kinds.

2d. Tumors dependent on the simple increase of size of already existing structures, in the tissues or organs in which they occur; as, for instance, fatty tumor in adipose tissues, exostosis in connection with bone, &c.

3d. Tumors dependent on the new growth of already existing structures, in situations where they are not normally found; as, for instance, a cartilaginous tumor in the midst of cellular tissue, or a fibrous tumor under a serous membrane.

I.—ENCYSTED TUMORS

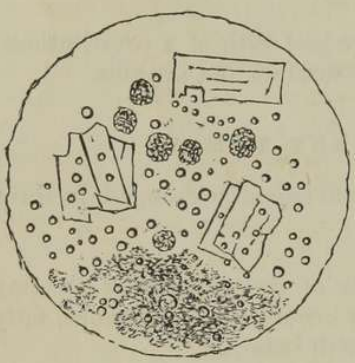
ENCYSTED TUMORS arrange themselves into two great classes. 1st. Those that are dependent upon the gradual accumulation of a secretion in a naturally existing duct or cyst, with dilatation and hypertrophy of its walls: 2d. Those that result from the new formation of a closed cyst in the cellular tissue of the part, and the distension of it by the secretion from its lining membrane.

1st. The encysted tumors arising from simple distension and gradual hypertrophy of the walls of a duct or cyst are met with in three forms. (α) As encysted tumors of the skin and subjacent cellular tissue occurring in various parts of the body, and dependent on the closure of the excretory ducts of the sebaceous glands: (β) As formed by the accumulation of secretions in, and the closure and dilatation of, the ducts of other secreting glands and organs, as in the sublingual or mammary gland: (γ) Those formed by the retention and modification of the secretions in cysts without excretory ducts, as in the bursæ.

(α) Encysted tumors occurring from the obstruction of the excretory duct of the sebaceous glands, include the various forms of *atheromatous* tumors that are met with on the surface of the body. These are usually situated upon the scalp, face, neck, or back; sometimes, however, they occur elsewhere;—thus I have removed a very large one from the forepart of a girl's arm, and others from the labia and groin. In size these tumors vary from that of a pin's head to an orange; the smallest occur on the eyelids, the largest on the shoulders and scalp. They are often very numerous, especially about the head, where as many as thirty or forty may be met with at the same time; and most frequently they form in women about the middle period of life: they are smooth, round, or oval, movable under the integument, either semi-fluctuating or elastic, though sometimes solid to the touch In some parts where the sebaceous follicles are

large, as on the back, a small black point can often be detected on the surface of the tumor, through which an aperture may be found leading into its interior, and admitting the expulsion of its contents. In structure they are composed of a cyst which varies greatly in thickness, being sometimes thin, filamentous, and soft; at others so thick, hard, laminated, and elastic, that it is almost impossible not to believe it to be a new formation; these cysts attain their greatest density on the scalp, and are here often very firm, elastic, and resisting, even though of but small size. In structure they are composed of cellulo-fibrous tissue, with an epithelial lining, and generally appear to be a dilated and hypertrophied state of the sebaceous follicles, though not improbably, as Paget supposes, they may at times be new formations.

Fig. 141.



They are usually attached by loose and lax cellular tissue to the subjacent parts; but, if thin, are often pretty closely incorporated with the super-imposed skin; if inflammation is set up around them they become more solidly fixed. The contents of these cysts are very various, most usually consisting of a soft, creamy, pultaceous, or cheesy-looking mass, of a yellowish-white color, which has sometimes in old cysts become dry and laminated, looking not unlike parmesan. In others, again, of old standing and large size, the contents may be found to be semi-fluid, the more liquid parts being of a brown, green, or blackish tint. These various contents are essentially composed of modified sebaceous secretion, such as epithelial scales, fat granules, cholesterine, granular matter, and rudimentary hairs in various proportions (fig. 141).

The growth of these tumors is often very slow, but not unfrequently after remaining stationary for years, they take on a rather rapid increase. The tumor itself, though painless, may give rise to uneasy sensations by compressing nerves in its vicinity; it usually continues to grow slowly until the patient being annoyed by its presence, gets it removed by operation. If left untouched, it occasionally, though rarely happens, that the sebaceons matter exuding through an aperture on its surface forms a kind of scab or crust, which by a process of sub-deposition becomes conical; and being gradually pushed up from below, at the same time that it assumes by exposure a dark brown color, forms an excrescence that looks like a horn, and is usually considered to be of that character (fig. 142). These "horns" have been met with on the head, on the buttock, and occasionally in other situations, and have been well described by Mr. Erasmus Wilson; some time ago a woman applied to me with one about an inch and a half long growing from the upper lip.

Fig. 142.

In other cases again, these tumors inflame and suppurate; the skin covering them becomes adherent and reddened, ulceration takes place, and if the cyst be small and dense, it may be thrown off by the suppurative action in the surrounding tissues. If of larger size, ulceration of the integuments covering it takes place, and the sebaceous matter is exposed; this may then putrefy, become offensive, and break away in unhealthy suppuration. In other cases again, peculiar changes take place in this tissue, large granulations are thrown out in it, and the atheromatous mass appears to vascularize, becoming irregular and nodulated, rising up in tuberous growths with everted edges, exuding a fetid, foul discharge, becoming adherent to subjacent parts, and assuming a semi-ma-

lignant appearance, forming at last a sore perhaps as large as a saucer, as in the annexed figure of a case sent to me by Dr. Bryant (fig. 143). Sebaceous cysts which have undergone this change may however readily be distinguished from such malignant growths by a microscopical examination of their exudation or débris, these consisting of pus and healthy epithelium, mixed up with fatty matters more or less disintegrated.

Fig. 143.

The only diseases with which these tumors can be confounded are abscesses and fatty growths. From an abscess an encysted sebaceous tumor may be distinguished by its history, slow growth, situation, elasticity, and mobility, and the existence of the dilated orifice of the sebaceous duct, through which some of the contents can be squeezed, the microscopical examination of which will serve to confirm the diagnosis. From a fatty tumor these growths may be diagnosed by their firmer and more regular feel, and in case of doubt by the evacuation and examination of their contents.

The *treatment* of a tumor of this kind simply consists in its removal, after which it is never reproduced. This may most readily be done by transfixing and cutting it across with the scalpel or bistoury, and then seizing the side of its cut edge with a pair of forceps, pulling the cyst out of its loose cellular bed. This plan may commonly be adopted with those seated about the head, face, or neck. When about the back, trunk, or limbs, they usually require to be dissected out, being more closely incorporated with the skin, and often adherent by former inflammation to the subjacent parts. In doing this, care should be taken that the whole of the cyst is extirpated; the wound that is left should then be dressed lightly, and speedily heals. If, however, any portion of the cyst be left behind, a troublesome fistula may remain. When occurring upon the scalp, a large number of these tumors may be removed at one sitting; as, however, there is always some danger of erysipelas following operations in this situation, it is only prudent to select a favorable season of the year, and not to operate if the tumor be in any way irritated at the time, or the health out of order. Erysipelas is especially apt to occur after these operations in elderly people of a stout make and florid complexion.

The horns and semi-malignant ulcers that result from these growths may require excision. If, however, the ulceration be connected with the cranium by its base, or be very extensive, as in the case depicted above (fig. 143), it will be safer to treat it by the application of a weak solution of the chloride of zinc, or by occasionally touching it with fused potass.

(β) Various forms of encysted tumor may arise from the closure and dilatation of the ducts of other excretory organs; as, for instance *ranula* by the occlusion of the salivary ducts, *encysted hydrocele* by the closure of the tubuli testis, or cystic tumors of the breast by the obstruction of the lacteal ducts. These affections, however, constitute special diseases, the consideration of which must be deferred to subsequent chapters. The general principle of treatment in these kinds of affection, consists either in restoring the freedom of the outlet by the excision of a portion of the wall, or obliterating the cyst by making an incision into it, and allowing it to granulate from the bottom.

(γ) *Cysts* may arise by the distension of cavities which are unprovided with any excretory duct; as for instance the bursæ which often attain a very considerable size under these circumstances. The structure of these cysts becomes greatly altered; sometimes the walls are thin and expanded; at others they

acquire a thick cellulo-fibrous, almost ligamentous, appearance Inside they are often warty-looking, from the deposition of imperfectly-organized fibrine, often arranged in a laminated form. Not unfrequently attached to the walls, and floating in the interior, are a number of granular, melon-seed-like bodies, greyish or yellow in color, semi-transparent, elongated or irregular in shape, usually rather hard, but sometimes soft and flocculent. These appear to be composed of masses of imperfectly-organized fibrine, somewhat resembling in structure granulation-cells, and often form in large quantities, so as to block up the interior of the cyst, converting it into a solid tumor. The fluid contents of these cysts are usually thin and serous, of a yellowish or brownish color. In their progress these cysts are found to increase up to a certain size, when they usually thicken and harden, in consequence of the fibrinous transformation just described; or else inflame and suppurate in an unhealthy manner. They may occur in any of the situations in which bursæ naturally exist or are accidentally formed, and which will be mentioned hereafter, but are most commonly met with upon the knee cap, the nates, or the first joint of the great toe.

The *treatment* of these cysts consists in attempting their absorption by the use of stimulating plasters; or, if this fail, in the removal of their contents by tapping. Their cavities are then closed by exciting inflammation and suppuration within them, by the introduction of a seton, by injection with stimulating solutions, or by the subcutaneous section. If these means fail, excision will be required, more especially if the tumor have assumed a dense and fibrous character.

2d. *Cysts* occasionally are met with as *new formations*, filling by their own secretion. They occur in the general cellular tissue, and in connection with the sheaths of tendons, but most frequently about the generative organs, more especially in the ovary, in the broad ligament of the uterus, or in the breast. These cysts vary most widely in size, from that of a millet-seed to tumors weighing many pounds, and filling up the greater part of the abdominal cavity. When small, they are usually thin-walled, and are often imbedded in a matrix composed of imperfect hypertrophy of the organ in which they are situated, as in the breast and testes; when large, as in the ovary, the walls are thick, firm, satiny, and often very tough. Projecting into their interior are solid masses, consisting of cauliflower-like growths, occasionally filling up the whole inside of the cyst with compact solid white layers. These "intracystic" growths cause by their increase in size the gradual absorption of the more fluid contents, until, at last, their development is arrested by the cyst wall.

These cysts may be divided into the *simple* and the *compound*. The *simple*, or, as they are commonly called, *serous* cysts, are met with in almost every situation, being composed of a thin expanded wall, containing a slightly viscid, serous fluid.

The *compound*, or, as they are often called, *proliferous* or *multilocular* cysts, are especially met with in the ovary, and have been studied with great care by Hodgkin. Of these there are two varieties, the first consisting of an aggregation of simple cysts closely packed and pressed together; the second composed of cysts having others growing from their walls. The cavities of these multilocular cysts present the greatest possible variety in their contents; fluid, from a limpid serum to a semi-solid jelly-like matter, and of every shade, from light-yellow to greenish-black, or dark-brown, is met with in them; solid intracystic growths, cancerous masses, or the débris of epithelial and cutaneous structures are also found in them.

Encysted tumors containing hair and fatty matters (*pilocystic tumors*), are occasionally met with. These would, in many instances, appear to be the remains of a blighted ovum inclosed in the body, as they are congenital, and usually contain some fœtal débris, such as portions of bone, teeth, &c. The

hairs in these tumors are connected with, and grow from, cuticular structures in which sebaceous follicles are commonly distinctly observable. The fatty matter which they contain in large quantity, and which may either be solid or perfectly fluid, is in all probability the result of fatty degeneration of the soft tissues of which they are composed. These tumors are most frequently met with in the abdomen, especially about the ovaries, mesentery, and omentum; they have also been observed in connection with the testes, having probably descended into the scrotum with this gland. A very remarkable case of this kind lately occurred at the University College Hospital under Mr. Marshall. They have also been found about the face, but never, I believe, in connection with the thoracic cavity or extremities.

The *sanguineous cyst*, or *hæmatoma*, is a peculiar variety of the simple form, and has been described by Paget as especially occurring about the neck, the parotid, the anterior part of the thigh, the leg, the shoulder, and the pubes. It is especially characterized by containing fluid blood, more or less altered in appearance. He describes these cysts as being formed in three different ways: either by hemorrhage into a previously existing serous cyst, by transformation from a nævus, or by a vein becoming occluded and dilating into a cyst. These sanguineous cysts may sometimes resemble in general appearance encephaloid disease. A case of this kind was sent to me by my friend, Dr. Henry Bennet—a tumor about the size of an orange, of nodulated appearance, existing in the leg of a woman below the knee, where it had been gradually increasing in size for about a couple of years. So close was the resemblance to malignant disease presented by the tumor, that the limb had been condemned for amputation by some surgeons who had previously seen the case; as, however, the growth, on examination, turned out to be a sanguineous cyst, as its walls were thin and adherent, and as it extended too deeply into the ham to admit of ready removal, I reduced it by successive tappings, and then laying it open, allowed it to granulate from the bottom. When practicable, however, the cyst should always be dissected out.

II. — TUMORS ARISING FROM SIMPLE INCREASE OF SIZE OF ALREADY EXISTING TISSUES.

These tumors differ from simple hypertrophy of the part "in this, that to whatever extent the hypertrophy may proceed, the overgrown part always maintains itself in normal type of shape and structure, while a tumor is essentially a deviation from the normal type of the body in which it grows." (Paget).

This section comprises, 1st, tumors connected with the integumental structures, as warts, polypi, &c.; 2d, lobular hypertrophies, with more or less modification of glandular structure, as in the breast; 3d, fatty tumors; 4th, vascular tumors; 5th, tumors of nerves; and 6th, tumors of bones.

1st. Simple tumors of this kind that develop on the integumental structures, whether cutaneous or mucous, are *warts* and *condylomata*. These essentially consist in an increased deposit of laminated cuticle, usually with some augmented vascularity of the cutis. They exist with especial frequency in the mucous, the muco-cutaneous, and the more perspirable surfaces; thus the prepuce, the vagina, the axilla, and the cleft of the nates are their chosen seats. When occurring on the skin, they are usually hard and horny where the cuticle is naturally dry, and then constitute true warts; but where the skin is perspirable, and the cuticle moist, they are flattened, expanded, soft, and white, and are then termed condylomata or mucous tubercles. When situated on the mucous membranes, they are usually pointed, somewhat pendulous, or nodulated on the surface, very vascular, and bleed readily when touched.

Closely allied to some of these warty structures is a peculiar pinkish-white fibro-vascular tissue, which is occasionally met with in old cicatrices as an out-

growth of these, and not unfrequently recurs after removal; this disease is termed *cheloid.*

The general principles of *treatment* of these affections consist in their removal by excision, ligature, or caustics, according to their size, situation, and attachments. Excision is usually preferable when they are seated on mucous surfaces; the ligatures should be used if they are large and pendulous, and caustics should be employed when they are seated on the skin or a muco-cutaneous surface.

Pendulous sarcomatous growths, forming large tumors commonly called "*wens,*" may occur on any part of the surface. They are smooth, pedunculated, firm, somewhat doughy, but non-elastic, pendulous, and movable, slowly increasing without pain, often to a very great size. It is in warm climates, and in the Hindoo and Negro races, that they attain their greatest development, having been met with fifty, seventy, and even a hundred pounds in weight. They are chiefly seated about the genital organs, enveloping the scrotum, penis, and testes in the male, or depending from the labia of the female. That remarkable enlargement of the leg occurring in the Mauritius, and some parts of the West Indies, and hence termed Barbadoes leg, is an affection of this kind. In structure these growths appear to be a simple hypertrophy of the fibro-cellular element of the part affected, being composed of a loose reddish stroma, moist with a serous fluid. In the treatment of these affections, pressure and iodine applications may be tried in the earlier stages, with the view, if possible, of checking their growth; at a later period they must, if large, be removed by operation, though this procedure is at times an extremely severe one, owing to the great magnitude they attain.

Polypi are pendulous masses growing from any mucous surface, but more especially from the nose, ear, throat, uterus, and rectum. The term polypus is applied very indiscriminately to various pendulous tumors growing from mucous membranes. The true *mucous* or *gelatinous* polyp is composed of the elements of this membrane expanded and spread out, and consists of a loose fibrous stroma covered by epithelium more or less distinctly ciliated, the cilia being often beautifully seen when recent specimens are examined under the microscope. The so-called *fibrous* or *medullary* polyp consists of other forms of tumor growing from, and covered by, mucous membrane. The true mucous polyp grows rapidly, being a soft and vascular reddish-purple or brown-looking mass, and may expand greatly, giving rise to serious symptoms of obstruction in the passage in which it is situate, bleeding freely when touched, destroying the bones by its pressure, and producing great mischief and disfigurement. It is especially in the nose and uterus that it attains to a large and dangerous size. The treatment consists in removing it according to its situation, its degree of vascularity, and the nature of its attachment, by avulsion, ligature, or excision.

2d. *Hypertrophy of glandular structures.* — This forms an important series of special affections, chiefly occurring in the lymphatic glands, the breast, and the testes. The parts becomes chronically enlarged and indurated, often without any signs of inflammatory action, though in other cases as the result of this condition. On examination, the structure of the gland will either be found to have undergone an imperfect and ill-developed hypertrophy in some of its lobules, or to be expanded and infiltrated with plastic matter, the consequence of chronic inflammation; or else to have undergone tuberculous deposition when occurring in strumous subjects. The principle of treatment in these tumors consists in an endeavor to remove the mass by frictions with the preparations of iodine, or by the application of stimulating and absorbent plasters. If these means fail, methodical pressure may sometimes advantageously be employed, and, as a last resource, extirpation by the knife.

3d. *Fatty tumors* constitute an important class of surgical diseases, as they occur very extensively in almost every part of the body, and at all ages, though

they are most commonly met with about the earlier periods of middle life. In the majority of cases they appear to originate without any evident cause; in other instances again they can be distinctly traced to pressure or to some local irritation, as to that of braces or shoulder-straps over the back and shoulders. In one case I have known the disease to be hereditarily transmitted to the members of three generations of a family.

Fatty accumulations take place under two forms, one diffused, the other circumscribed; it is only the latter variety that is termed the *adipose tumor*. The diffused form of fatty deposition occurs in masses about the chin or nates without constituting a disease, though it may occasion much disfigurement.

Fatty or *adipose tumors* may form in all parts of the body as soft, indolent, inelastic, and doughy swellings, growing but very slowly; being either oval or round, but not unfrequently lobulated, and occurring most frequently in the subcutaneous fat about the neck and shoulders; but occasionally met with between the muscles, in the neighborhood of joints, of serous membranes, as of the pleura, and of mucous canals. A very curious circumstance connected with these tumors is that they occasionally shift their seat, slowly gliding for some distance from the original spot on which they grew; thus, Paget relates cases in which fatty tumors shifted their position from the groin to the perineum or the thigh. I have known one descend from the shoulder on to the breast.

They may attain a large size, but only occasion inconvenience by their pressure or bulk; they rarely ulcerate or inflame, nor do they undergo any ulterior changes of structure.

These fatty growths have been divided into three varieties, according to their structural differences. The most common form of fatty tumor, that called *lipoma*, is a mass of yellow, oily, fatty matter and cellular tissue, inclosed in a fine thin capsule, having small vessels ramifying over its surface. This tumor is usually more or less lobulated, often remarkably dentated, and sending out irregular prolongations that extend to some little distance into the surrounding cellulo-adipose tissue. Another variety, the *cholesteatoma* of Müller, is of much less frequent occurrence; it is a smooth, laminated, white and dry fatty mass, contained in a cyst, and apparently composed of crystalline fat inclosed in meshes of cellular tissue. The third variety of fatty tumor consists of masses occurring in the ovary, or in multilocular cysts in other situations.

In the treatment of fatty tumors little can be done except by extirpation with the knife, by which the patient is speedily and effectually ridded of the disease. The tumor being encapsuled and but loosely adherent to adjacent parts, readily turns out and the wound often heals by the first intention. It is true that we have the sanction of Sir B. Brodie's high authority for the administration of the liquor potassæ in some of these cases, under which treatment this eminent surgeon states that fatty tumors have occasionally disappeared.

Fibro-cellular tumor. — This growth, described cursorily by many writers as the *cellular* tumor, has been more fully examined by Paget. It is not of common occurrence, and when met with it is most frequently found in the scrotum, the labium, the deep muscular interspaces of the thigh, and on the scalp, in which situations it may form tolerable large masses, attaining sometimes to a weight of many pounds. When occurring about the scrotum and labium, these tumors must not be confounded with elephantiasis of these parts, from which they may be distinguished by being limited and circumscribed masses, and not mere outgrowths. They happen only in adults who otherwise are in good health, and grow quickly, forming soft, elastic, rounded, and smooth tumors; they are not attended by any pain. After removal they are found to possess a thin capsule, to be of a yellowish color, and to contain a large quantity of infiltrated serous fluid, which may be squeezed out abundantly. As these

tumors are of a perfectly innocent character, no hesitation need be entertained about their removal.

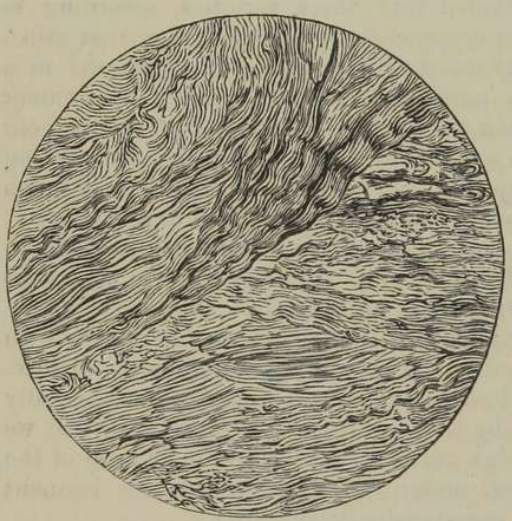
4th. Tumors dependent on an increase of the *vascular tissue*, as aneurism by anastomosis, — of the *nervous tissue*, as some kinds of neuromata, — and of *osseous tissue* as exostoses, and never extending beyond the structure primarily implicated, constitute such special affections, that it will be more convenient to reserve their consideration until we come to speak of the particular diseases of the structures to which they belong; and it will be sufficient for the present to indicate their existence as pertaining to this group.

III. — TUMORS DEPENDING ON THE NEW GROWTH OF STRUCTURES IDENTICAL WITH, OR VERY CLOSELY RESEMBLING, NORMAL TISSUES IN SITUATIONS WHERE THEY ARE NOT NORMALLY FOUND.

This class is an important one, inasmuch as it contains not only innocent growths, but some that are of a semi-malignant character. The fibrous, the fibro-plastic, and the enchondromatous tumors are those that are chiefly met with in it.

1st. *Fibrous tumors.* — These growths are by no means so common as many of the affections that have already been described; they are met with in various situations, as in the testes and mamma, uterus and antrum, about joints, in the periosteum, in the subcutaneous cellular tissue, and in connection with nerves. The situations in which they are most frequent, and where their structure is most typical, is in the neck, especially in the parotid region, in the uterus, and the antrum. In shape these tumors are irregularly oval or rounded; they are smooth, painless, and moveable, they grow slowly, but may attain an enormous size, equal to that of a cocoa-nut or water-melon. Liston removed one from the neck, which is at present in the Museum of the College of Surgeons, that weighed twelve pounds; they have, however, been found weighing as much as seventy pounds. They are almost invariably single, and when cut into present a white glistening ligamentous structure, being composed of nucleated fibres like those of ligamentous tissue (fig. 144.) These tumors may remain stationary for years, and this is the condition in which they are often presented to the surgeon. Eventually, however, they are apt to undergo disintegration, becoming infiltrated, œdematous, and softening in the centre, or at various points of the circumference; they then break down into a semi-fluid mass, the integuments covering them inflame, slough, and an unhealthy suppuration mixed with disorganized portions of the tumor is poured out, leaving a large and unhealthy slough chasm from which fungous sprouts may shoot up: readily bleeding on the slightest touch and giving the part a malignant appearance; the patient eventually falling into a cachectic condition, and becoming exhausted by the hemorrhage and discharges. In other cases again, these tumors may degenerate into a spongy calcareous mass of a brownish color and hard consistence; but they never undergo proper ossification. More rarely

Fig. 144.



Structure of fibrous tumor.

the interior of these growths softens and undergoes absorption, so as occasionally to form cysts of large size, containing fluids of various shades of color. Paget relates the case of a very large cyst of this kind formed by the hollowing out of a fibrous tumor of the uterus being twice tapped by mistake for ovarian dropsy. The treatment of these tumors is in a great measure palliative, but when so situated as to admit of removal, as in the neck, under the angle of the jaw, or in the antrum, they should always be extirpated.

2d. The next class of tumors, though closely resembling the fibroid in structure, have a great tendency to recur after removal, to disintegrate and contaminate neighboring parts and even the system at large. They are in their appearance innocent, but in their course malignant. This class comprises the so-called *semi-malignant* tumors, viz., the *malignant fibrous*, the *recurring fibroid*, the *fibro-plastic*, and the *enchondromatous tumors.*

The *malignant fibrous tumor* closely resembles in its general appearance and microscopic elements the ordinary fibrous growths, but its great characteristic is its recurrence after removal, with much tendency to ulceration, sloughing, and hemorrhage, forming not only in its original locality, but in internal parts of the body at a distance from it.

The *fibro-plastic or myeloid tumor* was first described by Lebert, and has been investigated by Paget, who finds it to stand intermediate in structure between the fibrous and fibro-cellular, resembling pretty closely that of granulation-cells in the process of development into fibro-cellular tissue, having parallel fibres with wide fibro-plastic cells, and occasional oat-shaped nuclei. It is found about the jaws, in the bones, in the cellular tissue of the neck, and in the mammary gland.

These tumors, the albuminous sarcoma of Abernethy, present marked characters. On making a section of them they cut in a uniform, smooth, and somewhat elastic manner; are semi-transparent, shiny, and juicy-looking, of a greenish-grey, bluish or pinkish color, often spotted or stained with discolored marks, varying in tint from a blood to a pinkish, brownish, or livid red hue, which, if extensive, gives them a fleshy look; their structure is usually brittle. They most commonly occur in young people, without pain and without any known cause. In the majority of cases they may be safely removed without the prospect of recurrence, but occasionally, and without any apparent reason, they return after removal. Lebert relates six cases of this disease in which recurrence took place after operation, with secondary deposits in internal organs.

The *recurring fibroid tumor* has been described by Paget as closely resembling in general aspect the common fibrous tumor, whilst in its microscopic structure it is very like the fibro-plastic tumor, its most marked character being its tendency to recur after removal. Of this peculiar and hitherto undescribed disease, he relates two cases, one a tumor of the upper part of the leg, which, between 1846 and the end of 1848, had been removed five times, re-appearing for the sixth time after the last operation, when, attaining a large size, and becoming ulcerated, amputation was deemed advisable; this operation, however, was followed by death. The examination of this tumor presented "very narrow, elongated, caudate, and oat-shaped nucleated cells, many of which had long and subdivided terminal processes." In the second case, a tumor of the shoulder had been removed, and returned four times between May, 1848, and December, 1849, re-appearing in the following year for the fifth time, the patient, notwithstanding, appearing at this period to be a strong and healthy man. He also relates a case by Gluge, in which a similar tumor was five times removed from the scapula, its sixth re-appearance being followed by death. The most interesting of all, perhaps, is a case by Dr. Maclagan, in which, after three removals, no further recurrence of the disease took place. It is a remarkable circumstance that these recurrent tumors appear, according to Paget, to become

more malignant in their growth in the later than in the earlier recurrences, acquiring more and more the characters of true malignant disease, becoming more painful, rapidly degenerating, and giving rise to an ulcerating fungus, which eventually proves fatal by exhaustion and hemorrhage.

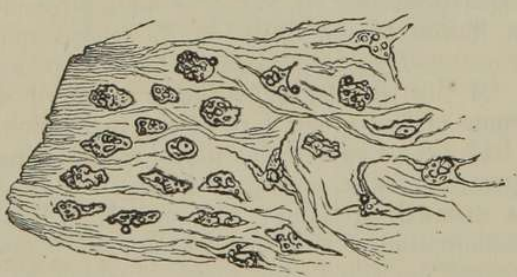
3d. *Enchondroma*, or the *cartilaginous tumor*, carefully studied by Müller, and investigated by Paget, is an exceedingly interesting affection, whether we regard the peculiarity of its structure, its comparatively frequent occurrence, or the large size that it occasionally assumes. It takes place under two distinct forms; most commonly as an innocent growth, but in other cases assuming a malignant tendency and appearance. These two forms present different signs; in the first case, the echondroma occurs as a hard, smooth, elastic, ovoid, round, or flattened tumor, of small, or but of moderate size, seldom exceeding that of an orange, and growing slowly without pain. In the second form, it approaches in its characters to malignant disease, growing with extreme rapidity, attaining an enormous size in a few months, and contaminating the system by the deposit of secondary echondromatous growths in internal organs; under these circumstances, it would appear to have occasionally been mistaken for the rapidly spreading forms of encephaloid disease.

But although occasionally assuming the course that is usually adopted by true malignant growths only, it must be borne in mind that enchondromata, especially of the testes, are not unfrequently associated with encephaloid; and when so, the secondary deposits are usually of the latter character only, although in some rare cases even these have been found of a mixed nature.

When these growths attain a tolerably large size, though occasionally whilst they are still of but moderate dimensions, ossification may occur in some parts; whilst a process of disintegration may take place in others, they soften, break down, and liquefy in their interior, causing the skin which covers them to become duskily inflamed, eventually to slough, and to form fistulous openings, through which a thin jelly-like matter is discharged. In some cases it would appear that large tumors of this description, softening in the centre, and becoming elastic and semi-fluctuating, have been mistaken for cysts, and have been tapped on this supposition. In small enchondromata the opposite condition more frequently occurs, the tumor becoming indurated, and undergoing ossification.

The accompanying cut is a good illustration of the microscopical characters of these tumors (fig. 145). It shows a clear matrix, in places thinly granular, in others slightly fibrous, imbedded in which are cells and nuclei of various forms and sizes, some round or irregularly oval, from $\frac{1}{200}$th to $\frac{1}{800}$th of an inch in diameter. Many are branched or caudate; some of the spheroidal cells are granular, others have nuclei of irregular outline; interspersed among them are a few oil globules. The general appearance is that of fœtal cartilage, from which it can with difficulty be distinguished.

Fig. 145.



Most frequently enchondroma occurs in connection with some of the short bones, more particularly those of the metacarpus and the phalanges of the fingers, presenting hard rounded knobs in these situations, where, however, it seldom attains a greater magnitude than a walnut or a pigeon's egg. When large, it is commonly met with in or upon the head of the tibia, or the condyles of the femur, forming in these situations rapidly increasing growths of considerable magnitude. It may also form in the parotid region, in the muscular

interspaces of the neck, thigh and leg, and in the testes. When connected with the bones, enchondroma may either spring from the periosteum, gradually enveloping, absorbing, and eventually destroying, the osseous structures, though at first not incorporated with them. This is their usual mode of origin when occurring in the femur or tibia: when seated on the short bones, especially on the metacarpus and phalanges (figs. 146, 147), they commonly spring from the interior of the osseous structure, expanding, absorbing, and involving its walls in the general mass of the tumor. When occurring in cellular regions unconnected with bone, the enchondroma is softer, and does not present such distinct cartilage cells as in the osseous *enchondroma*. Most frequently these enchondromatous masses occur in childhood, or shortly after puberty, appearing as it were to be an overgrowth of the cartilaginous element of the osseous system at this period of life.

Fig. 146.

The *treatment* consists either in excision of the tumor, or amputation of the affected part. Excision may be practised when the tumor is seated in the parotid region, or otherwise unconnected with bone. When forming a part of the osseous structures, it cannot well be got rid of without the removal of the bone that it implicates by amputation. If, under these circumstances, excision of the tumor only be attempted, it will be found that the whole mass cannot be removed, and that it rapidly grows again, or that the wound formed by the operation remains fistulous and open. Most commonly a permanent cure is effected by the ablation of the tumor in one or other of these ways, but cases have occurred of the more rapidly growing form of the disease recurring, after its removal, in a softer state than before, and with a close approximation to malignancy in appearance and action. It is worthy of remark, as showing the connection between enchondroma and malignant disease, that cartilaginous masses have been met with in the midst of encephaloid tumors of the bones and testes.

Fig. 147.

CANCER.[1]

Having now considered innocent tumors, that have no tendency to contaminate neighboring structures, or to return after removal; and the semi-malignant, which, though innocent in structure, are malignant in their course, and, under

[1] It is not my intention to enter largely into the general history of malignant diseases, as space will not admit of my doing so; I would therefore refer my readers who wish for further information on this interesting subject to the works of Abernethy; the papers by Lawrence; the admirable and magnificent "Illustrations of the Elementary Forms of Disease," by Sir R. Carswell; to the excellent and copious monograph by Dr. Walshe; and to Mr. Paget's philosophic Lectures on this subject. In these different sources will be found nearly all the information at present possessed by the profession on the important and interesting subject of Cancer.

certain obscure conditions, local or constitutional, as yet undetermined, have a disposition to recur after operation; we next proceed to the study of that form of malignant growth which has, as it were, a natural and constant tendency to affect the system, to implicate neighboring structures, and to return in its original site, or at a distance from it, after extirpation.

Cancer differs from all normal structures by being distinctly and essentially a new product, never, under any circumstances, existing in a healthy system, and possessing vital properties and an organization that is peculiar to itself. Cancer presents itself in four if not five varieties, which differ so much from one another in appearance, in rapidity of growth, in consistence, color, and structure, as at first sight almost to appear to constitute essentially different diseases, but yet having so close a family resemblance, and presenting so many points of identity, that, physiologically and pathologically speaking, they must be considered as mere varieties of the same class of tumors. The varieties of cancer generally admitted are the *scirrhus*, or the hard cancer; *encephaloid*, or the soft cancer; *colloid*, or gelatinous cancer; *melanosis*, or the black cancer.

We meet with cancer, in one or other of these forms, usually the encephaloid, associated with some of the normal constituents of the body. With cartilage, as *chondroid;* with bone, as *osteoid;* with an erectile vascular structure, as *aneurismal;* and with epithelial cells, as *epithelial cancer*. Other varieties of cancer are met with, deriving their distinctive characters from some peculiarity of structure. Thus, when cysts are largely developed in the substance or in the surface of the growth, we have *cystic cancer;* and when the surface assumes a dendritic and papillated character, the form of the disease is termed *villous*.

These various forms of cancer differ from one another in appearance and consistence; the *scirrhus* being hard, firm, semi-transparent, of a bluish or greyish color; the *encephaloid* being brain-like in appearance, soft, and hemorrhagic; the *colloid* resembling glue, or honey in its comb; the *melanosis* being black, sometimes solid, at others liquid; and the *epithelial* form occurring as nodules or ulcers, presenting peculiar characters. They vary also in the rapidity of their growth, in their vascularity, and in the order of their malignancy, in all of which respects they may be arranged as follows: 1st. Encephaloid; 2d. Scirrhus; 3d. Melanosis; 4th. Colloid; 5th. Epithelial cancer.

Great as the differences amongst them are, however, the points of resemblance are still more striking; thus, one form of cancer may take the place of another, or be associated with it; encephaloid occurring after the removal of scirrhus, or being associated with melanosis; or colloid and scirrhus being met with together in the same tumor. This identity of seat and of recurrence, which tends more than anything else to establish a common origin amongst these tumors, has been specially pointed out by Carswell. Then, again, these tumors are all of a truly malignant character, having a tendency to induce a peculiar and similar condition of system that goes by the name of the *cancerous cachexy*. In chemical composition, also, they are all very nearly identical, being principally composed of albumen.

The microscopic characters of the different forms of cancer have of late years attracted considerable attention amongst pathologists. They consist, in all the varieties, essentially of the same elements, though these may differ somewhat in appearance and in relative preponderance, in the different forms of the affection. In all there is a fibrous stroma or basis, firmer and closer in some, as in scirrhus, than in the others. This yields, by scraping or pressure, a turbid fluid termed the *cancer juice*, in which granules, cells, pigmentary and fatty matters, are found in varying proportion. The granules, which are minute, sometimes amorphous, at others presenting that peculiar vibratory condition termed the molecular movement, are met with in all the varieties of cancer,

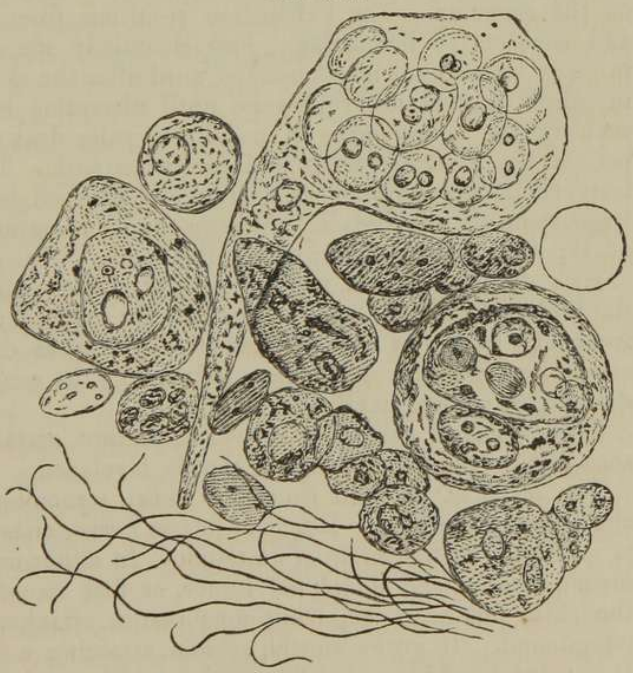
though they occur in largest quantity in scirrhus. The cells to which great importance has been attached by various observers, and which have often been looked upon as characteristic, or pathognomonic, of the disease, though erroneously so in the strict acceptation of the term, present, however, such peculiar characters, that it is almost impossible to mistake them. They are large, spherical, fusiform or spindle-shaped, elliptic or caudate, having often two or three terminations, are usually compound, granular, have large nuclei, and prominent, well-marked nucleoli (fig. 148). These various appearances are presented by them in all forms of the disease; it is, however, more especially in the encephaloid variety that they assume a large size, and present their most marked fusiform and caudate shapes (fig. 149). The pigmentary cells are principally, if not altogether, found in melanosis.

Fig. 148.

Cells from Scirrhus of Breast (rapidly recurring).

Much diversity of opinion exists amongst surgeons as to the value that should be attached to these microscopic signs in determining the true nature of many tumors; some being guided by these appearances alone, others looking upon them as uncertain and fallacious, and trusting rather to the general characters of the growth. The latter, however, appears to me to be too limited a view of the subject, for although the unaided eye of an experienced surgeon may in many cases recognize the true character of a tumor, and the microscope in some few instances fail to reveal it, yet there can be no doubt that, in many cases, it is only by the aid of this instrument that the real nature of the growth can be determined.

Fig. 149.



Cells from Encephaloid of Tongue (rapidly growing).

It is doubtless true that every one of these microscopic elements may separately occur in the normal tissues and secretions of the body, some in those of the adult, others, as the caudate and fusiform corpuscles, in the embryo; but though this be the case, it does not appear that they are ever found in any tumors except those of a cancerous nature; and in these it is rather by the aggregation of these appearances, than by any single one in particular, that the true character of the disease is determined. In these examinations, however, the experienced surgeon will find that the appearances presented to the naked eye will assist him much in pronouncing upon the malignant or cancerous character of the tumor. It is certainly a remarkable

circumstance, that the "recurring," or semi-malignant diseases, as well as those that are truly cancerous or positively malignant, present, under the microscope, structures that closely resemble those of tissues in process of development, either in form of imperfect exudative matter and fibro-cellular tissue, as in the fibro-plastic tumors, or in the similarity presented by the corpuscles of encephaloid to some of those of the soft tissues in the embryo.

The general characters that attend the progress of these several forms of cancer present numerous points of resemblance. When once formed, the tumor continues progressively to increase in size with a degree of rapidity, and to an extent, that varies according to its kind; the scirrhous tumors growing most slowly, and attaining but moderate dimensions; the encephaloid and colloid often with great rapidity, and to an immense size. When the full growth of the tumor is attained, the process of decay commences. The mass softens at some point, the skin covering which becomes duskily inflamed and ulcerated, an irregular sloughy aperture forming, through which the débris of the mass are eliminated in an ichorous or sanious fluid, having often a peculiar fetid smell. The ulcer then pretty rapidly increases, with everted edges, a hard and knobby or soft and fungating surface, and the discharge of a dark fluid, often attended by hemorrhage, and occasionally with sloughing of portions of the mass. Coincident with the implication and ulceration of the skin, there is usually deposit in the lymphatic glands, with great increase of pain, and most commonly with the supervention of the constitutional cachexy; though in some cases this condition precedes the cutaneous implication. This cachexy appears to be the result of the admixture of cancer germs with the blood, and their circulation through the body; or to some other modification in the condition of the blood, induced by the action of this growth on the economy. The exhaustion resulting from the ulceration, sloughing, and consecutive hemorrhage, also commonly increases this cachectic state; in many instances it is not marked until after the skin has become affected, and in others it does not supervene until ulceration is actually set up. In this cachexy the countenance is peculiarly pale, drawn, and sallow, so that the patient has a very anxious and care-worn look. The general surface of the body commonly acquires an earthy or yellowish tint, and not unfrequently large spots of pityriasis or chloasma make their appearance on various parts of it; the appetite is impaired, the voice enfeebled, the muscular strength greatly diminished, and the pulse weak. The patient complains of pains in the limbs, of lassitude, and of inability for exertion; he emaciates rapidly, and frequently suffers by the occurrence of cancerous deposits in internal organs; and at last dies from exhaustion, induced by the conjoined effects of weakening discharges, general debility, and pain.

These general characters, however, present certain varieties of importance, according to the form of cancer that is developed.

The *scirrhus*, or hard cancer, is most commonly met with in the breast and lymphatic glands. It occurs in two forms, either as a circumscribed mass, or infiltrated in the tissue of an organ. In either case it forms a hard, craggy, incompressible, and nodulated tumor, at first movable and unconnected with the skin, but soon acquiring deep-seated attachments, and implicating the integument. It grows slowly, seldom attaining a larger size than an orange. It is painful, aching generally, at times with much radiating and shooting pain through it; these sensations vary according to the part affected, and to the sensibility of the individual; the pains are especially severe after the tumor has been handled, and at night are of a lancinating, neuralgic character. It may thus continue in a chronic state for a considerable length of time, slowly increasing, gradually extending its deeper prolongations and implicating the more superficial parts. In some cases, more particularly in elderly people, scirrhus gives rise to atrophy of the organ in which it is seated, causing

wrinkling and puckering of the surrounding skin, which becomes adherent to the tumor, which may thus continue in a very chronic state.

The ulceration usually takes place by the skin becoming adherent at one point to the tumor either by dimpling in, being as it were drawn down towards it, or else by being pushed forwards, stretched and implicated in one of its more prominent masses; it then becomes of a dusky and livid red, somewhat glazed, and covered by a fine vascular net-work. Softening occurs at one point, where a crack or fissure forms; a clear, gummy drop of fluid exudes from this, and dries in a small scab upon the surface; this is followed by a somewhat bloody discharge of a thick and glutinous character; and the small patch of skin from which it issues becoming undermined, speedily sloughs away, leaving a circular ulcer. This gradually enlarges, becoming ragged and sloughy, with craggy everted edges, having irregular masses arising from its surface, and discharging a fetid sanious pus. The pain increases greatly, and the lymphatic glands becoming involved the cachexy is fully developed, and the patient is destroyed by it, or by the secondary visceral deposits. In old people, ulceration of scirrhous masses often assumes an extremely chronic character, the growth in them not being endued with the same vitality as in the young. The ulcer in these cases is flat, sloughy, of a greyish-green color, hard and rugged, with puckered edges, much wrinkling of the surrounding skin, and exhaling the usual fetid odor. In younger persons, and especially in stout women with florid complexions, this disease usually makes rapid progress. So also, if inflammation be accidentally set up in the neighboring tissues, cancerous infiltration takes place in them, in consequence probably of the products of inflammation effused around the tumor undergoing cancerous transformation almost as soon as deposited. I had lately under my care an old man with a cancerous tumor of the leg, which, after remaining stationary for seven years, became accidentally inflamed, and has since then increased with very great rapidity. Occasionally, but very rarely, scirrhous masses slough out, leaving a large ragged cavity, which may even cicatrize, and thus a spontaneous cure has been known to have occurred. The cancerous infiltration will extend to a considerable distance around the tumor into integument that to the naked eye appears quite healthy, but which with the microscope will afford unequivocal evidence of the existence of cancer germs diffused through it. The cancer infiltration extends like a halo around the original tumor, and very probably shades off into the surrounding textures. It is of great importance in determining the question of operation to bear this in mind, and not to act on the supposition of the tumor being distinctly and abruptly defined.

The secondary deposits from scirrhous tumors may take place in the viscera, or the lymphatic glands; in the former situation, they are usually of an encephaloid character, in the latter they assume the scirrhous form.

After a scirrhous tumor has been removed, though still feeling firm under the fingers, it is not so hard as when it was in the body, owing, as Dr. Walshe observes, to the escape of its fluids and consequent loss of turgescence. On cutting it with a scalpel it usually creaks somewhat as it is divided, and presents a whitish or bluish-white glistening surface, intersected by white bands, which apparently consist partly of new structure, partly of included cellular tissue. This section has not inaptly been compared to the appearance presented by a cut through a turnip or an unripe pear, hence termed *napiform* and *apinoid* by Walshe; and from its reticulated character, *carcinoma reticulare*, by Müller. On examining the fibrous stroma, or net-work, which forms the basis of the tumor, it will be found to be composed of fibrous or fibro-cellular tissue. The soft greyish-blue granular material seated in the meshes of this, may be squeezed or scraped off in a liquid state as cancer-juice. This is composed of a multitude of nucleated corpuscles, granules, granular cells, and globular, caudate, or spindle-shaped bodies.

The *encephaloid* or *soft* cancer, or, as it is often termed, *medullary sarcoma*, is the most malignant and rapidly-growing form of this disease. It is met with in the globe of the eye, in the nares or other cavities of the face, in the articular ends of bones, the testes, and the breast, and often attains an enormous size, equal to that of an adult head, or of half the body. It occurs in two stages, either as a tumor, encysted or infiltrated, or as a fungus after protrusion through the skin.

It commences as a tumor, which, though occasionally somewhat hard, is usually from the first, or at all events soon becomes, soft and elastic, being more or less lobulated, growing rapidly, and having a semi-fluctuating feel. The skin covering it is at first pale and loose, with a large net-work of blue dilated veins spreading over it. As the tumor enlarges, the skin becomes adherent, discolored, of a purple-brown tint, and at last ulcerates at one point; from this a large fungous mass, rugged, irregular, dark-colored, and bleeding profusely, rapidly sprouts forth, constituting the affection to which Mr. Hey gave the appropriate term of *fungus hæmatodes;* when once this condition has been reached death rapidly ensues from exhaustion and hemorrhage. Pulsation has been met with in particular forms of very vascular encephaloid; in these cases also a loud bruit has been detected that may be heard on the application of a stethoscope, synchronous with the pulsation and the heart's action. These symptoms have been most frequently met with in encephaloid tumors connected with bones, and may, unless care be taken, cause the disease to be confounded with aneurism.

The constitutional cachexy in encephaloid occurs early, and is well marked, and secondary affections of the lymphatic glands and viscera often take place, occasionally of a scirrhous character.

After removal the tumor is found to be very vascular, displaying on injection a close net-work of vessels. On a section being made, it commonly presents a soft pulpy white mass, closely resembling cerebral substance, stained and blotched with bloody patches, varying in color from a bright red to a maroon-brown, and dependent on blood that has been infiltrated into its substance. In other cases again, its section has been compared to that of a raw potato or a piece of boiled udder. On closer examination its tissue will be found to consist of a stroma of delicate fibres supporting the soft medullary or brain-like structure; this may be seen to be composed in a great measure of large quantities of corpuscles, nucleated, compound, and granular, fusiform, angular, clubbed, or caudate, often with two terminations.

The *colloid*, *gelatinous*, or *alveolar* cancer, may occur in distinct masses, often of very large size, or be infiltrated in the tissue of organs; as it is most commonly met with in the viscera, it does not so often fall under the observation of the surgeon as the other varieties of cancer. Yet it may form superficially, as is shown by a preparation in the University College Museum of a scirrhous breast containing colloid.

In structure it consists of cells filled with a clear semi-transparent yellowish gelatinous or honey-like material, resembling indeed exactly the structure of a honey-comb. The septa forming these cells are distinctly fibrous, and regular in their arrangement. The gelatinous matter contains caudate and nucleated cells in considerable quantity, presenting the same characters as those of the other varieties of cancer.

Melanosis or *black* cancer, has been specially studied by Sir Robert Carswell, who arranged it under the heads of *punctiform* melanosis, in which the dark pigmentary matter occurs in the shape of minute points or dots scattered over a considerable extent of surface. The *tuberiform* melanosis, occurring in tumors which vary in bulk from a millet-seed to an egg or an orange, always assuming a globular, ovoid, or lobulated shape, and being principally met with in the cellulo-adipose tissue, or on the surface of serous membranes. The *stratiform*

and *liquiform* melanosis, which take place principally upon serous membranes, or in accidental cavities where the black pigmentary matter looks not unlike Indian ink. Melanosis most frequently presents itself to the surgeon in connection with the eye, occasionally in the skin and subcutaneous cellular tissues, and rarely in the bones. It resembles somewhat in its general progress and characters the encephaloid form of cancer, ulcerating and throwing out dark fungous masses; occasionally indeed, as Carswell has pointed out, it is distinctly associated with the other varieties of this disease. In microscopic structure it somewhat resembles encephaloid, consisting of a stroma, with caudate, granular, and compound cells, but containing a large quantity of pigmentary matter in granules, molecules, and masses.

The *diagnosis* of the different forms of cancer is not always easily made. Scirrhus when in tumor may very readily be confounded with fibrous tumors and various chronic glandular masses, or with the indurated atrophy of a part; in many of which cases indeed the diagnosis cannot be correctly effected until after removal. In other cases, however, the rugged feel, the lancinating pains, the tendency to the implication of the lymphatics, or to affection of the general health, will commonly serve to establish the diagnosis. When ulcerated, the previous condition of the tumor, the general character of the sore, and the microscopic examination of the débris, may serve to establish its true character.

Encephaloid in tumor, may be confounded with abscess, cysts, fatty, erectile, and sanguineous tumors; and when pulsating, with aneurism. In these cases careful palpation, the existence of elasticity, without fluctuation, and the presence of the large and tortuous veins ramifying over the surface of the mass, may establish its true character. When it is fungating, it might be confounded with the sprouting intra-cystic growths, that sometimes spring from the interior of a cystic tumor. Here however a microscopic examination of the débris, as well as the existence or not of contamination of neighboring lymphatics, will establish the true nature of the affection.

The *causes* of cancer are often exceedingly obscure. In many cases it undoubtedly is of an hereditary character, Velpeau says, in more than one-third of the patients he has met with, not that the disease itself is existent at birth, but that the tendency to it is connate; that tendency manifesting itself at those periods of life and in those organs in which cancer usually develops itself. It may, however, actually be a congenital affection; thus it has been met with in the eye at birth, and in the Museum of University College, is a preparation of a small melanotic tumor existing in the cerebellum of a child that only lived three days after birth. It may occur at all periods of life from the earliest ages; and will evince itself in persons from eighty to ninety years of age. According to Dr. Walshe, the mortality from cancer goes on steadily increasing till the eightieth year; hence the popular belief that the middle period of life is most obnoxious to it, would appear to be an erroneous one. All forms of cancer are not however met with in equal frequency at all ages; the encephaloid being the most common in the young, and scirrhus in the middle-aged and elderly. Colloid rarely occurs before the age of thirty. Cancer often appears without any exciting cause, when it is evidently, as in hereditary and connate cases, the result of some peculiar constitutional condition, the nature of which is altogether unknown to us, but under the influence of which the peculiar growth characterizing it springs up. In many cases, however, it can be distinctly traced to some exciting cause, being immediately occasioned by a blow, injury, or other violence, or by a long-continued irritation of the part, that eventually becomes affected; thus in women a blow on the breast often gives rise to cancer, and the irritation of a broken tooth may occasion it in the tongue. It is a question whether external causes of this kind can give rise to the production of cancer without the previous existence of constitutional predisposition to the disease. That cancer even when apparently excited by local causes, may

in reality be of constitutional origin, cannot admit of a doubt; more especially in those cases in which it is hereditary, or in which it makes its appearance almost simultaneously in different parts of the body with a strongly marked cachexy. But in many other instances it certainly appears to be strictly local in its origin, as when it slowly occurs after the infliction of some violence, and without any evidence of constitutional disturbance or contamination. Velpeau truly observes, that those organs which are most exposed to external irritation and violence, are most liable to cancer. It is impossible to look upon those cancers as *ab initio* constitutional, which arise from external causes in an otherwise healthy individual, slowly increasing in size without any tendency to multiplication or sign of constitutional cachexy, until by the implication of the neighboring lymphatics or glands the cancer germs have entered the system. It is true that it may be argued that the cancer could not be excited locally in these cases, unless a tendency to it already existed in the system. But this appears to me to be a begging of the whole question; there is no proof of the existence of any constitutional infection at the time of the occurrence of the disease, or until it has existed for a sufficient length of time for the lymphatics to be affected and the blood to be poisoned; and it certainly appears to be more reasonable to look upon the local disease as the primary affection, occurring originally in a healthy constitution, but after a time infecting the system generally, than to regard the mere local manifestation as in itself a proof of the constitutional nature of the disease. It is true that we are ignorant of the manner how a cancer-germ can be produced by the local action of the part in which it is generated, but we are as little acquainted with the essential mode of production of an exudation-cell or of a pus-corpuscle, which we know to be the result of strictly local actions; and it seems to me that the difficulty is in no way solved, but simply pushed back a step by the attempt to prove that in all cases of cancer-formation, a constitutional cause or predisposition exists, which impresses the cancerous character upon local actions taking place in such a system. The cases in which cancer appears to be primarily and strictly a local affection, influencing the constitution secondarily, are by no means of unfrequent occurrence—we commonly see for instance, a woman in perfect health receive a blow upon the breast, which gives rise to some passing inconvenience at the time; after a lapse of some weeks, though still with an unimpaired state of health, she notices a small lump of a scirrhous character. This may continue stationary, or but slowly increase for months or years, and it is not until the lymphatics become enlarged, and the glands in the axilla indurated, that the constitution begins to suffer, and a tendency to secondary deposits to manifest itself In such cases as these it is in vain to argue that the cancer could not have sprung up unless there were a constitutional tendency to it. There is in these cases no evidence whatever of any affection of the constitution, or of any general predisposition to cancerous disease, until after sufficient time has elapsed for the germs to be absorbed, and the blood to be poisoned by them (p. 410).

TREATMENT OF CANCER.

The *treatment* of cancer may be considered to be of a constitutional and of a local character. All *curative* constitutional treatment is, I believe, utterly useless in cases of cancer, no constitutional remedies appearing to have any influence on the progress of this disease. I am not acquainted with any case of cancer, either from my own observation, from conversation with other surgeons, or from published statements, that affords satisfactory evidence of any internal remedy having cured this disease. It is true that many so-called cases of cancer have, at various times, been stated to have been cured by different medicines, but it must be borne in mind, that in a less advanced state of pathological knowledge than exists at the present day, almost all hard chronic

tumors were called scirrhous, and many intractable ulcers, cancers; mistakes which are not unfrequently committed, and sometimes unavoidably so, even with the improved means of diagnosis that we at present possess. Not one of the many remedies that have been vaunted as being specific in this disease, and by which cures have been stated to have been effected, has obtained the confidence of the profession, or has, on further trial, corresponded in its effects to the statements of those who introduced it. I therefore think it but waste of time to discuss the supposed advantage to be derived from hemlock, sanguinaria, iron, arsenic, and iodine, in the treatment of cancer. But though curative treatment can effect nothing in these cases, much may be effected in cases that do not admit of operation towards the alleviation of the patient's sufferings, and perhaps even towards retarding the progress of the disease, by proper *palliative* treatment. With this view, the diet should be mild, nutritious, easy of digestion, unstimulating, and sufficient to support the strength under the wearing influence of pain and discharge; and the preparations of opium, of conium, and hyosciamus, must be freely administered in order to relieve the patient's sufferings, and to procure rest.

The *local* means are those upon which the surgeon places the greatest reliance in these affections. In order to prevent the rapid extension of the tumor, it is of great importance to subdue all local excitement going on within and around it; in proportion to the amount of action existing in the part the disease will usually extend with rapidity; any inflammatory condition of the neighboring tissues being especially prejudicial in this respect. Hence, under these circumstances, the occasional application of a few leeches will often be of considerable service. No counter-irritation, however, ought to be employed in the vicinity of the cancerous part, as it only excites action in and around it, and hastens the process of ulceration; the skin especially is apt to become rapidly infiltrated by the cancerous disease under it, if irritated by the application of iodine and other stimulants. If the tumor be painful, and the skin covering it still unbroken, great relief may be obtained by the application of belladonna plasters. In some cases I have found powdered conium spread on cotton wadding, useful in the same way. As it is of importance to prevent, as long as possible, any breach of surface, the application of these sedative plasters and powders should be persevered in with the view of supporting the integument. The local application of ice, so as to freeze the tumor more or less completely, has been recommended of late years by Dr. J. Arnott; it may, possibly, in some cases retard the growth or lessen the pain, but there is no evidence to show that it can be considered as a curative agent.

When the tumor is ulcerated, the fœtor must be diminished by the application of weak solutions of the chlorides, to which opiates may be advantageously added with a view of lessening the pain.

Caustics.—The employment of caustics for the destruction of cancers is of old date, and their use has, in all ages and countries, been resorted to by empirics, who profess to remove, by secret remedies less painful and more efficacious than the knife, tumors of a malignant nature. As their application, to use Velpeau's expression, requires neither a knowledge of anatomy or of operative surgery, they have always been popular with many who would hesitate to use the knife. In this country, however, they have never enjoyed any very extended reputation, and in fact have, perhaps, not been legitimately employed to the extent that they deserve, especially in ulcerated and recurrent cancers, or in those so situated on the skin and muco-cutaneous surfaces as not to admit of being very readily or safely extirpated by operation.

The great objection to the use of caustics has been the severity and the continuance of the pain induced by them, lasting not only for hours, but for days — more intense and prolonged than any occasioned by the knife; and as it is usually necessary, in order to destroy effectually the morbid growth, to repeat

the application of the caustic several times, the suffering is often greater than the most resolute patient can submit to.

The chief argument in favor of caustics is that when cancers are thus destroyed they are less liable to relapse than when extirpated by the knife. There is, however, no positive evidence in proof of this before the profession; but it is not improbable that the chemical action of the caustics may extend so widely into neighboring tissues as to destroy or render unproductive the cancer cells by which they are infiltrated, and on the development of which the local recurrence of the disease depends. Another advantage urged in favor of caustics, in the correctness of which Velpeau acquiesces, is, that enlarged lymphatic glands are more likely to go down under their use than when the primary cancer is extirpated by the knife. Some of the advocates of the use of caustics in the treatment of cancer pretend that the agent employed exercises a specific action on the morbid structure, which is confined to it, and does not extend to the neighboring healthy tissues. But this assertion is entirely destitute of foundation.

The caustics that have been and that are employed in the treatment of cancers are very various. They cannot be used indiscriminately, and consequently we must briefly consider them separately.

1. *The concentrated mineral acids*, especially the anhydrous nitric and sulphuric, are often advantageously employed. The concentrated nitric acid may be usefully applied to small superficial cancerous ulcers; it rapidly destroys the tissues, and does not spread too widely, but it is not potent enough for the destruction of tumors. The glacial sulphuric acid, rubbed into a black paste with powdered saffron, is the caustic which Velpeau extols as the most efficient in cancerous tumors, more particularly if of a fungating or bleeding kind. It converts the part to which it is applied into a thick, hard, carbonized eschar, with but little surrounding inflammation, and as its action is rapid, the pain is not prolonged. On the separation of the hard slough, a healthily granulating cavity will be left, which cicatrizes rapidly with much contraction. It also acts as a hemostatic, rapidly shrivelling and drying up large bleeding and discharging fungi.

2. *The caustic alkalies*, especially potass and lime, either alone or in combination, in the shape of the Vienna paste, or fused into sticks, are very energetic in their action, but they have the disadvantage of spreading widely if applied to a large surface, and by softening or dissolving the parts, giving rise to a tendency to hemorrhage. They may, however, be advantageously used to small cancers of the face.

3. *Various mineral salts*, more particularly the chlorides of antimony, zinc, and bromium, the acid nitrate of mercury, and the arsenious acid, are often employed with much success in the treatment of cancers, ulcers, and growths.

Of the various chlorides, that of zinc is the most useful. This is applied by being made into a paste with from one to four parts of flour, moistened with a little water. It must, in order to act, be applied to a raw surface. M. Canquoin states that a paste, made of equal parts of the chloride and of flour, four lines in thickness, and applied for forty-eight hours, destroys the parts to the depth of one-and-a-half inch. Where of less strength and substance, its action is proportionately limited. It may sometimes be used in the form of small sticks, which are pushed deeply in several directions into the substance of the part to be destroyed. In other cases the tumor may be deeply and rapidly attacked by applying a layer of the chloride of zinc paste over the whole of its surface. The slough produced by this application is then incised in several directions, until the parts beneath, to which the caustic has not penetrated, are reached by the incisions so made; pieces of lint covered with the paste are put into them, and afterwards fresh incisions made, until the cauterizing influence is extended to the bottom of the tumor, which finally sloughs out in a mass. Of the utility of

his caustic there can be no doubt, but the chief objection to its use is the intensity and continuance of the pain occasioned by it. Mr. L. Parker has suggested that this may be prevented or lessened by freezing the part. Landolfi has recommended the use of the chloride of bromium in combination with those of gold and zinc, but this caustic does not appear to possess any decided advantage over the simple chloride of zinc, and is objectionable on account of the fumes evolved during its use.

Arsenic exercises a powerful action upon cancerous growths, and constitutes the chief ingredient in many of the secret preparations used by empirics; it is, however, a dangerous agent, and excites great inflammation and pain. If too freely used, it may induce poisoning, and not a few deaths have resulted in this way; it should, accordingly, not be applied to a surface exceeding a shilling in size at one time. The most convenient mode of applying it appears to be Manec's paste, composed of one part of arsenious acid to eight of cinnebar, and four of burnt sponge, rubbed down to a proper consistence with a little water.

The sulphate of zinc, dried, finely levigated, and made into a paste with glycerine, or an ointment with axunge, has been very strongly recommended by Dr. Simpson, as one of the most efficient and convenient of all caustics in rodent and cancerous ulcers. In action it somewhat resembles the chloride of zinc, but is less painful.

The *treatment by compression* is a plan that has been alternately greatly extolled and much depreciated. It was fully tried at the Middlesex Hospital, by Mr. Young, forty years ago, and unfavorably reported upon by Sir Charles Bell at that time; it consequently fell into disuse in this country, but was revived by Recamier in France, and employed largely by him. Although he published a favorable account of this practice, it made but little progress amongst French surgeons, the only one who seems to have used it to any extent being M. Tanchou, who employs a peculiar topical medication conjoined with it. In this country the practice fell into complete oblivion, until Dr Arnott, some years ago, invented a mode of employing pressure by means of an elastic air-cushion; since which time it has been pretty extensively employed with varying degrees of success.

In employing pressure, Young principally had recourse to plasters and bandages. Recamier used amadou applied with an elastic roller; and Tanchou recommends spring pads, under which small bags or pieces of cotton wadding impregnated with various medicinal substances are placed, so as to protect the skin and act upon the tumor. Dr. Arnott's plan consists of pressure exercised by a Mackintosh air bag, held in its place by straps, and pressed upon by a truss-spring, the pressure exercised by which may be made to vary from two-and-a-half to twelve or even sixteen pounds. These different plans should not be employed indiscriminately, but may all be of service in particular cases. I have employed all these methods, but have never found any permanent advantage from any of them.

The first question that necessarily arises in reference to the employment of pressure in these cases, is whether it can effect a cure. This it could only be expected to do by producing atrophy and the subsequent absorption of the strictly local forms of cancer. The only case on record, with any pretension to a conclusive character in this respect, is one related by Dr. Walshe, in his excellent "Treatise on Cancer," of the cure of a tumor of the breast, believed to be cancerous, by compression. But even this instance I cannot look upon as by any means conclusive; for although no one can entertain a higher opinion than I do of the very remarkable diagnostic tact possessed by Dr. Walshe, yet I think there can be no doubt in the mind of any surgeon that it is absolutely impossible to determine in many cases, by any amount of diagnostic skill, the true nature of a chronic tumor of the breast, and that in fact we constantly see the most experienced practitioners find after the removal of the tumor that it was

of a different character to what they had previously anticipated. This difficulty attaches to Dr. Walshe's case, and I think that we possess no proof that the tumor of the breast, which underwent absorption under the pressure of Dr. Arnott's apparatus, was of a truly cancerous character, and that it might not have been a chronic mammary tumor or some similar growth, that we know will disappear under this kind of treatment.

But if compression cannot be shown ever to have cured a cancer,—can it not retard the progress or relieve the sufferings attendant upon this disease? I believe that in some cases it may certainly do both, though in others it is as unquestionably injurious. It appears occasionally to retard the growth of the tumor, when applied in the early stage, simply by preventing its expansion, and perhaps by diminishing the supply of blood sent to it by compressing its nutrient vessels, and by causing absorption of surrounding inflammatory infiltration; in these cases likewise it relieves for a time the pain by lessening the turgescence of the part. In other cases, however, I have known it to act injuriously by pressing out and diffusing the tumor more widely, appearing to increase the tendency to implication of neighboring parts, and occasioning great suffering. When the tumor is ulcerated, or if the skin covering it is inflamed, pressure cannot be employed with any advantage; and most commonly irritable, sensitive patients cannot support the constriction of the chest that it induces.

Excision.—With regard to the question of removing cancers by the knife, much difference of opinion exists amongst surgeons, for though all deprecate indiscriminate recourse to this means in this affection, some go so far as to dispute the propriety of ever operating for this disease, whilst others restrict the operation to certain cases of a favorable character. These questions are necessarily of considerable importance, and require attentive consideration.

The great objection that has been urged against operating in these cases is, that cancer being assumed to be from the first a constitutional affection, it is useless to remove the local tumor, leaving the constitutional vice (p. 406). For such an argument as this to have any value, it must first be shown that cancer is *ab origine* a constitutional affection, and that it is not a local disease in the first instance, which being allowed to remain unchecked will at last contaminate and poison the system. The evidence we possess would, however, rather lead us to the opposite conclusion, namely, that cancer is originally local, and only becomes secondarily constitutional. This opinion, which Velpeau strongly supports, is founded on the following reasons:—

1st. We constantly see cancerous tumors spring up in individuals who have always enjoyed perfect health, and who are to all appearances perfectly well at the time of the occurrence of the disease.

2d. These tumors are not unfrequently the result of some local injury or irritation.

3d. The constitutional health does not in the majority of cases appear to suffer until some weeks or months have elapsed, when as the lymphatics or glands become implicated, or neighboring tissues invaded, signs of cachexy set in.

4th. If the disease be removed in the early stage and before neighboring parts have become contaminated, the health often improves materially.

5th. In the great majority of cases the patient remains free from any recurrence of the disease for some considerable period.

6th. In some instances no recurrence whatever takes place, the disease being eradicated from the system, which could not be the case if it were constitutional.

7th. We observe the same tendency to recurrence after removal, and to secondary deposit in distinct organs in other tumors which are incontestably primarily local, such as the fibro-plastic and the enchondromatous, and only become constitutional in their more advanced stages, and in a secondary manner.

The objections that have been urged against the general propriety of operating in cases of cancer, do not apply so much to the operation itself, the risk attending which is not greater than that of other operations of similar magnitude, as to the liability of the patient speedily suffering from a return of the disease, so that an operation that is at least unnecessary will have been performed. That this objection is in a great measure a valid one, is undoubted; the experience of all surgeons tending to establish the fact that the majority of patients operated upon for cancer die eventually, and usually within a limited time, from a recurrence of the disease. Thus, Sir A. Cooper states, that in only nine or ten cases out of a hundred, did the disease not return in three years; and Brodie has found that it generally proves fatal in two or three years after the operation. After removal of the tumor, the disease may return in the cicatrix, even before this is healed: in the neighboring lymphatic glands with or without the cicatrix having been involved, or in internal organs. When it returns in the cicatrix, it usually makes its appearance in the form of small hard nodules of a purplish-red color, and covered with a very thin integument, which speedily runs into ulceration, presenting the ordinary characters of the cancerous sore. The disease is especially apt to recur if the skin have become involved, if the lymphatic glands are enlarged, or if there be constitutional cachexy before the operation; so also if the tumor is growing rapidly at the time of removal, and especially if the patient be robust and strong with a florid complexion.

In determining the question of operating in cases of cancer, several points of great importance present themselves for the consideration of the surgeon. He has first to consider whether the operation is likely to free his patient completely from the affection; or, in the event of its not doing so, whether at least life may not be prolonged by the removal of the cancerous tumor; and, lastly, even though the patient be eventually carried off as speedily as he otherwise would have been, whether his sufferings may not be much lessened by the removal of the local affection.

That in some cases a cancerous tumor may be removed with every expectation of the patient being completely freed from the disease, cannot, I think, be doubted; although it may be true that such instances are not of frequent occurrence. Yet they not unfrequently fall under the observation of surgeons, and would certainly tend to prove that the affection is not in all cases of a constitutional character, and that if we can happily succeed in removing it during its local condition, there is a good prospect that the patient may be rescued from a return of the affection. Velpeau states that he has perfectly cured patients by the removal of cancerous tumors, at least that no return has taken place for 12, 15, or 20 years after extirpation. The evidence of Sir B. Brodie on this point is extremely valuable; writing in 1846, that eminent surgeon states, that "So long ago as 1832, I removed a breast affected with a scirrhous tumor, and the lady is still in good health—at least, she was so last year. Since the operation she has married, and had children. Last year I was called to see a lady on account of another complaint, on whom I performed the operation thirteen years ago, and found that she continued free from the old disease; and, very lately, I have heard of another lady, whose scirrhous breast I removed six years ago, and who continues well." The evidence of Mr. Fergusson is also very positive on this point, and he speaks in a manner with which I perfectly agree. He says, "Nevertheless, as excision gives the only chance of security —a point on which most parties seem to agree—an operation should always be resorted to, provided the knife can be carried beyond the supposed limits of the disease; and, moreover, I deem it one of the duties of the practitioner to urge the patient to submit to such a proceeding." The opinions of these eminent surgeons, supported as it is by the general practice of the profession, tends to show that in some cases, at least, the disease may apparently be extirpated from

the system by excising the tumor before the constitution has become implicated. But even though, in many cases, we may not expect to accomplish so desirable a result as this, and to cure the patient completely by operative procedure, may we not reasonably hope to improve his health, to prolong his life, or to relieve the sufferings to which he is subjected, by this means. I am decidedly of opinion that we may do so, and though a patient may at last be carried off by some of the recurrent forms of cancerous disease, his health may have been improved, his life may have been prolonged, and much suffering may have been spared him by a timely operation. This is more particularly the case in encephaloid cancer, in which early removal of the disease is unquestionably successful, in many cases, in prolonging life. The observations of Mr. Paget, on this point, are peculiarly valuable. He states the average duration of life of those patients laboring under this form of disease, in whom the primary affection is removed, to be about 34 months; whilst the average life of those in whom the disease is allowed to run its course, is scarcely more than one year.

But I think that the introduction of anæsthetic agents into operative surgery has very materially altered the bearings of this important question. So long as an operation was a source of great pain, and of much consequent anxiety and dread, a surgeon might very properly hesitate in subjecting his patient to severe suffering with so doubtful a result; but now that a patient can be freed by a painless procedure from a source of much and constant annoyance, discomfort, and suffering, the surgeon may feel himself justified in thus affording him a few months or years of comparative ease, though he may be fully aware that at the expiration of that time the affection may return, and will certainly prove fatal. Even then, his condition may be much improved, for the recurrent is often less distressing to the patient than the primary disease, for, as it often takes place in internal organs, it is not attended with the same amount of local pain and distress.

In discussing the propriety of operating in a case of cancer, the surgeon can, however, have little to do with general or abstract considerations. He has to determine what had best be done in the particular case that he is actually considering, and it will serve him little in coming to a conclusion as to the line of practice that he should adopt, to refer to the statistics of the gross results of operations, or to general comparisons between the results of cases that are not operated upon and those that are. The whole question narrows itself to the point as to what should best be done in order to prolong the life, or relieve the suffering, of the particular individual whose case is being considered. In order to come to some definite conclusion on this, it is necessary to classify the different cases of cancer, and to arrange them under the heads of those in which no operation is justifiable; those in which the result of any such procedure would be very doubtful; and, lastly, those in which an operation is attended with a fair prospect of success.

Cases not admitting of operation. — 1st. The operation ought never to be performed in those cases in which there are several cancerous tumors, existing in different parts of the body at the same time. Here the disease is evidently constitutional, and could not be eradicated by any series of operations. 2d. Then, again, if the cancerous cachexy is strongly developed, or if the disease be hereditary, it is useless to remove a local affection, as the malignant action will certainly manifest itself elsewhere, or, perhaps, even speedily return in the cicatrix. 3d. So also if the tumor be of very rapid growth, and be still increasing, there would appear to be so vigorous a local tendency to cancerous deposit, that it will speedily develop itself again in the cicatrix. 4th. If the tumor be so situated that it cannot be completely and entirely extirpated by cutting widely into the surrounding parts, it ought not to be meddled with; otherwise the affection will to a certainty return in the cicatrix before it has closed. It is not alone necessary to remove the tumor, but the surrounding

tissues to some extent, even if apparently healthy. 5th. If the whole of the affected organ, as a bone, cannot be removed, or, if the skin and glands be involved, it is useless to attempt the extirpation of the growth, as a speedy relapse may be confidently looked for. 6th. In the very chronic and indurated cancers of old people, it is often well not to interfere, as in these cases the affection makes such slow progress, that it does not appear in any way to shorten life, and the mere operation might be attended with serious risk at an advanced age.

Doubtful cases. — Those cases in which the result of an operation is of an extremely doubtful character, but in which no other means offer the slightest prospect of relief to the patient, have next to be considered. 1st. Cancers of the eye, tongue, and of the testes belong to this category, for though more liable to return than similar affections of any other part of the body, yet they may be considered fit cases for operation, inasmuch as in no other way has the patient the slightest chance of being relieved from his disease. 2d. In those cancers that are already ulcerated, the surgeon may sometimes operate in order to give the patient ease from present suffering, or, perhaps, as in some cases recorded by Brodie, with the view of prolonging the duration of life; but he can have little expectation of effecting a permanent cure. 3d. If the tumor be of so large a size, or be so situated that its removal cannot be undertaken without so serious an operation as to occasion in itself considerable risk, the propriety of operating is always very doubtful.

Cases for operation. — Those cases of cancer in which an operation is, in my opinion, not only perfectly justifiable, but should be urged upon the patient as affording the best prospect of preserving his life, are those in which the disease has appeared to originate from a strictly local cause in persons otherwise in good health, in whom there is no cachexy or hereditary taint. If the tumor be of a scirrhous character, slow in its progress, single, distinctly circumscribed, without adhesions to, or implication of, the skin or glands, and more especially if it be attended with much pain, or with immediate risk to life from any cause, and if the whole of the growth, together with a sufficient quantity of the neighboring healthy tissues in which it is imbedded can be removed with care, the case may be looked upon as a fit one for operation.

In all encephaloid cancers also, early operation should be practised with the view of prolonging life.

An important question in connection with operations for cancer, is at what period of the growth they may be done with the best prospect of success. Most surgeons, taking a common-sense view of this question, are in favor of removing the affection as early as possible, feeling that as it is difficult to say when the local form of the disease becomes constitutional, it is safer to remove it as soon as its true nature has been ascertained; and I confess that I can see no advantage that can be gained by delay. The necessity for early operation in *medullary* cancer is admitted by all, but with regard to *scirrhous* cancer, the opinion is entertained by some, that in many cases there is a better prospect of success if the operation be delayed: and it is stated by Hervez de Chagoin and Leroy d'Etiolles, that the result of those cases operated on after the cancer has lasted for some time, is more favorable than that of those in which an early operation has been done; the cancer often appearing to be arrested in its development and to localize itself as it becomes more chronic, and having consequently a less tendency to speedy return after removal. That the result of operations in such selected cases is favorable, is probable enough, as it may be reasonably supposed that the more active varieties of cancer, those that possess the greatest amount of vegetative activity and of reproductive power, may have got into a condition unfavorable to operation, or even may have carried off the patient before any period of arrest in their growth has occurred, during which their extirpation could be practised with a fair prospect

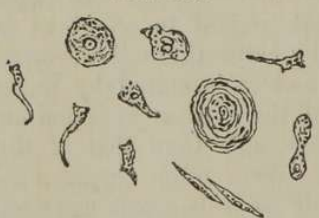
of success. In delaying operation there is, however, much danger lest valuable time be lost in the employment of means which, ineffective in arresting the disease, may become positively injurious by allowing time to the morbid growth to contaminate the glandular system, or to extend widely through neighboring tissues. If we look upon a cancer as a morbid growth that must necessarily destroy life, either by changes taking place in its own substance or by the contamination of the system, and that is intractable to all medication, whether topical or constitutional, we must look upon its extirpation as the only resource that Surgery offers; and we may assuredly infer, that the liability to constitutional infection, and wide-spread local contamination, will be less in proportion to the early removal of the morbid mass.

EPITHELIAL CANCER.—EPITHELIOMA

Epithelial cancer differs from the other varieties of the disease in its anatomical structure, in being seated on the cutaneous, or more frequently, the mucous or muco-cutaneous surfaces; and in its being but very seldom the cause of secondary visceral deposits. It resembles the other forms of cancer, however, in its tendency to local infiltration and ulceration, in its extension to the lymphatic system, and in the induction of death by cachexy.

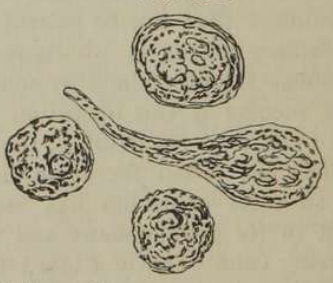
This affection is chiefly met with in the neighborhood of the outlets of the body, upon the muco-cutaneous surfaces, being commonly seated upon the lips, the tongue, the cheek, the scrotum, the anus, and the uterus; but it may occur upon the skin of the extremities and trunk, chiefly in the hands, feet, and back. It commences either as a small tubercle, which rapidly ulcerates, or appears from the first as an intractable ulcer of limited size, with hard and everted edges, and a foul surface; it slowly spreads, and appears at first to be local, but after a time contaminating the glands in the neighborhood, it induces cachexy, and destroys the patient by exhaustion. It seldom occurs secondarily in the viscera, though, the liver, lungs, and heart have been observed to be affected; but extensive deposits in the lymphatic glands in the vicinity of the parts affected, even deep in the iliac and pelvic regions, invariably take place after the disease has lasted for some time. It may form in the submucous cellular tissue as a distinct rounded pendulous or fibrous-looking tumor. I removed lately such a growth from the inside of the cheek of an old woman; it looked fibrous on section, but was an epithelial cancer, about the size of a cherry, round and pedunculated. On examination an epithelial cancer will be found to be composed of a fibrous basis, with a large quantity of condensed and morbid epithelial scales, closely packed upon it. These scales so closely resemble those of the

Fig. 150.



Cells from epithelial cancer of lower lip.

Fig. 151.

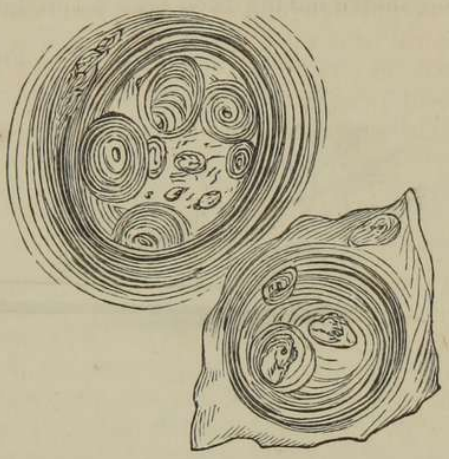


Cells from chimney-sweep's cancer.

epidermis and epithelium, that they cannot be distinguished from them, but their arrangement is different; they are packed together in masses or balls, assuming a concentric arrangement, hence termed "Concentric globes" (figs. 150, 152), and in these present a somewhat fibrous appearance. According to

Mr. Simon, however, this fibrous structure is deceptive, depending upon the scales being much attenuated and woven together. In many cases they are intermixed with globular bodies, and in others with cells of various shapes, resembling those found in the more truly cancerous diseases (figs. 150, 151); and indeed so close is the resemblance between the compound nucleated cells commonly met with in epithelial cancers with those of the other cancerous affections, that I know of no way of distinguishing them from one another, and must look on these growths as of a hybrid character.

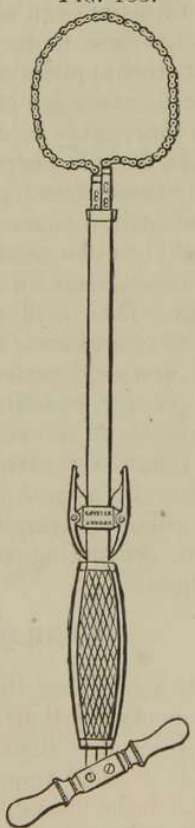
Fig. 152.



The treatment of epithelial cancer is more satisfactory than that of the other varieties of carcinomatous disease which we have just been considering, inasmuch as this partakes more of the characters of a local and less of a constitutional affection than any other form of cancer. Hence free removal by excision or ligature, or complete destruction by caustics, will not uncommonly permanently rid the patient of this affection.

Excision should always be preferred whenever practicable, and should be done as soon as the nature of the disease is recognized, the part being thoroughly extirpated, together with a good wide margin of healthy tissue on either side of and beneath it, so that no cancer-germs may be left from which new growths can spring. When the neighboring lymphatic glands are but slightly enlarged, the operation may be done equally, the glandular enlargement, which may be dependent on irritation, gradually subsiding. If, however, it be more considerable, the affected gland must be extirpated, but if there be a chain of enlarged glands, more especially in the deeper cavities, no operation should be undertaken, as the disease will then have become constitutional and cannot be fully removed. If the disease be situated on one of the extremities, as the hand or foot, partial or complete amputation even may be the safest procedure, and such cases are less liable to relapse than others in which such free extirpation is not admissible.

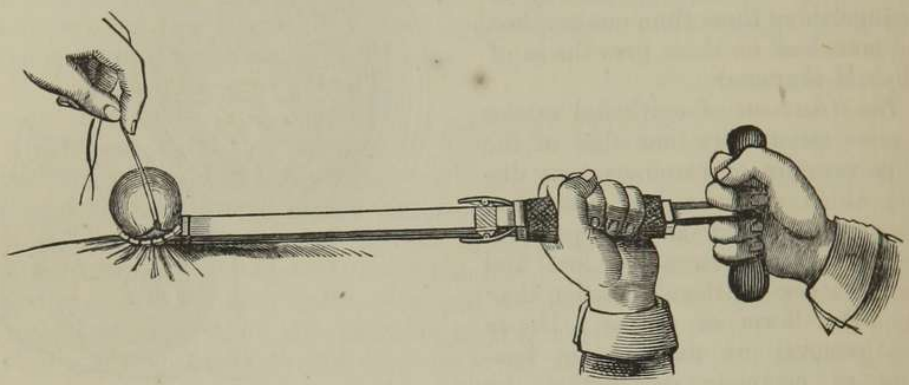
Fig. 153.



The ligature may be advantageously employed when the cancer is so situated that incision is impracticable, either on account of dangerous hemorrhage or from the impossibility of effectually extirpating the disease. The part having been well insulated, and effectually strangled by stout whipcord ligatures, sloughs and separates in a few days. Of late a more rapid process of strangulation has been invented by M. Chassaignac, who, by means of the "*ecraseur*" (fig. 153), removes with little or no hemorrhage, in the course of a few minutes, cancroid and other growths of considerable size, by a process of rapid strangulation and crushing in a linear direction. The ecraseur consists of a loop of fine steel chain, which having been passed over the tumor or through the tissues to be removed, is gradually tightened by a mechanism in the stem to which it is attached. In applying this

instrument it is often necessary, first of all, to insulate and raise the tumor to be removed by passing a thread through or under it (fig. 154), and then having applied the chain's loop round its base, to tighten this by working the handle every ten or fifteen seconds, until the mass is detached. The resulting wound is small and puckered in, and often heals with but little trouble. If the mass to be removed is large, two or more ecraseurs may be used at the same time, the chains having been passed through the tissues by means of a needle. This

Fig. 154.



instrument appears to me to be chiefly applicable to cases in which, as in cancroid ulcer of the tongue, excision is hazardous on account of the hemorrhage attending it, while the ligature is objectionable on account of the fetor and discharge resulting from the slow separation of the sloughs.

Caustics.—In some instances the disease being so situated, as in some parts of the face, or in the deeper cavities of the body, that it cannot be dissected out, the application of caustics will be useful in procuring its removal; but if these agents are employed, care should be taken that they be freely applied, so as thoroughly to destroy the whole of the morbid textures. The best preparations for this purpose are concentrated sulphuric acid, arsenic, the chloride of zinc paste, fused potassa cum calce, the potassa fusa, the Vienna paste, and the acid nitrate of mercury. All of these may be applied successfully, though they should not be used indiscriminately. The chloride of zinc and the Vienna paste are most useful when the ulcerated surface is large, and indurated at its base or edge. The acid nitrate of mercury should only be employed when the sore is small, superficial, irregular, and without much induration. In such cases, also, the arsenical pastes and powders already described are very useful. In epithelial cancer, constitutional treatment is, I believe, as ineffectual as in the other varieties of the affection.

When a recurrence takes place after operation for epithelial cancer, it is either by a fresh deposit of cancerous matter in the cicatrix, or else by the neighboring lymphatic glands which had been contaminated before the operation, continuing to enlarge, and at last ulcerating, and thus destroying the patient.

OPERATIONS FOR THE REMOVAL OF TUMORS.

In describing the different forms of encysted tumor, the operative procedures necessary for their removal have been adverted to. We may now conveniently consider the steps that are generally necessary for the extirpation with the knife of solid tumors from the soft parts. In the removal of tumors, the first point to be attended to is the arrangement, shape, and direction of the necessary incisions. These should not only have reference to the size of the growth, extending well beyond it at either end, but must also be planned with due

regard to subjacent parts of importance. As a general rule, they should be carried in the direction of the axis of the limb or part, and parallel to the course of its principal vessels; they must not only extend over the whole length of the tumor, but also a little beyond it at either end; no cross-cuts should be made, if they can possibly be avoided, and this may usually be done by the proper position, and extension of the linear incision. In most cases, no skin should be removed, a simple cut being made; but if the integumental tissues be either very abundant and loose, or else are adherent, an elliptical portion of them may be excised together with the tumor. In other instances, again, a semilunar flap of integument may with advantage be turned up from the tumor, the surface of which is then fairly exposed; this, however, can only be done in some simple tumors, such as fatty growths. The flaps covering it should then be freely but cautiously dissected back, so as to expose the sides and base of the growth; as these are approached, and the surgeon gets in the neighborhood of its more important and deeper connections, increased care will be necessary, as it not unfrequently happens that the tumor is in more important relations with deep-seated blood-vessels and nerves of a large size than would at first appear. When practicable, the deep dissection had best be commenced and carried out from that part of the base of the tumor into which the principal blood-vessels appear to enter; they are thus early cut, and being once ligatured give no further trouble, as they would do were they divided from the direction of their branches towards the trunk, when at each successive stroke of the knife a fresh portion of the vessel would be touched. In carrying on this deep dissection, the operator should proceed methodically from one side of the tumor to the other, the assistants holding aside the skin so as to give as much room as possible, whilst the surgeon himself, seizing the mass with his left hand, or with a large double hook or vulsellum, and dragging it well forwards, uses the knife by successive strokes, but in a leisurely and careful manner, avoiding all undue haste, until he completely detaches it from its connections. The safety of contiguous important structures will be best secured by keeping the edge of the knife constantly directed towards the tumor, if this be of a non-malignant character; by attention to this rule, I have seen Mr. Liston remove tumors with remarkable facility and ease from the neighborhood of most important parts. If, however, the growth be of a malignant character, the incisions must be made wide of the disease into the healthy structures around; if this be not done, slices of the tumor may be left from which fresh growths rapidly sprout, or cancer-cells may impregnate the neighboring tissues through which they are scattered, and may eventually become so many fresh centres of malignant action. After the tumor has been removed, it must be carefully examined, with the view of ascertaining whether it is entire, and if any portions have been left behind, these must be properly dissected out. In some situations, as the axilla, or side of the neck or groin, where the relations are of great importance, the less the edge of the knife is used the better, and the growth should be enucleated with the surgeon's fingers, or with the handle of the scalpel. If it be found that the tumor extends more deeply than had been anticipated, and comes into such close relation with important vessels, as at the summit of the axilla or in the perineum, as to prevent the surgeon dissecting it out without imminent risk of destroying the patient, the only alternative left is one that I have seen Mr. Liston adopt, and have had occasion myself to practice in these situations, viz., to throw a strong whipcord ligature above the apex of the growth as high up as practicable, and then to cut off every thing below this. On the separation of the ligature, any portion of the tumor that has been included will be brought away as effectually as if it had been done with the knife.

In some cases it will be found, after dividing the fascia covering the tumor, that the attachments of the growth are not so firm or deep as had been previously expected; this is especially the case in some large tumors springing

from the side of the neck and the parotid region, or in the groin; then it may often be removed in a great measure by separating the cellular tissue with the handle of the knife, merely dividing those portions of the deeper attachments that are of a peculiarly dense character. The surgeon should never undertake the removal of tumors that cannot be wholly and entirely extirpated, as the part left behind will always grow with greatly increased rapidity, often assuming a fungous character; this is especially the case with malignant tumors, the rapidity of increase of which is greatly augmented by partial operations. Should, however, the surgeon have been deceived as to the depth and connections of the mass, and should he find after commencing his operation that it is so situated as not to admit of entire removal, he must, under the circumstances, do his best, and cut off or remove by the ligature as much of the growth as he can expose with safety.

The wound that is left after the removal of a tumor, usually unites partly by adhesive inflammation, and partly by the second intention; it should be lightly dressed, the edges being brought together with strips of plaster and water-dressing, and if large, supported by a compress and bandage.

CHAPTER XXX.

SCROFULA, OR STRUMA.

By *scrofula* is meant a peculiar constitutional condition, either hereditary or acquired, that leads to the formation of, and in its full development is characterized by the presence of, tubercle. It is, however, only when fully developed that scrofula gives rise to the local deposit of tuberculous matter. The constitutional condition that tends to this is sufficiently characteristic; but although we may recognize its existence, and speak of the individual possessing such a constitution as having a scrofulous tendency or diathesis, he can scarcely be considered to labor under the fully formed disease unless tubercle be deposited in some of his tissues or organs.

The scrofulous diathesis is a peculiar constitutional state that is often erroneously confounded with general debility. It may, and often does, co-exist with this, but is by no means synonymous with weakness of constitution. Debility often exists without any scrofulous tendency or taint, more particularly in individuals of the nervous temperament; many delicate people, though weak, being perfectly healthy, and showing no disposition to this peculiar affection; on the contrary, the scrofulous constitution is often conjoined with much muscular power and mental activity. But though no weakness may be manifested in either of these respects, scrofula is invariably conjoined with debility or perversion of the nutritive activity of the body. This is especially manifested in certain tissues, such as the mucous and the cutaneous; and in those organs, the vitality of which is low, as the lymphatic glands, the bones, and the joints. In these, scrofula is especially apt to influence the products of nutrition and of inflammation, more particularly during the earlier periods of life when these actions are most energetic, in such a way as to render its existence evident to the surgeon. It is this tendency to the occurrence of particular diseases, and to the engrafting of special characters on affections of certain tissues, that may be considered as specially indicative of the existence of the scrofulous diathesis; of that condition which, in its extreme of development, gives rise to the deposit of tubercle in organs and tissues. The existence of this diathesis is marked by

the presence of a peculiar temperament, by special modifications of the seat, form, and products of inflammation, and, lastly, by the development of tubercle.

The scrofulous temperament assumes two distinct forms, and each of these presents two varieties. The most common is that which occurs in persons with fair, soft, and transparent skin, having clear blue eyes with large pupils, light hair, tapering fingers, and fine white teeth; indeed, whose beauty is often great, especially in early life, being dependent rather on roundness of outline than on grace of form; and whose growth is rapid and precocious. In these individuals the affections are strong, and the procreative powers considerable; the mental activity is also great, and is usually characterized by much delicacy and softness of feeling, and vivacity of intellect. Indeed, it would appear in such persons as these that the nutritive, procreative, and mental powers are rapidly and energetically developed in early life, but become proportionately early exhausted. In another variety of the fair scrofulous temperament, we find a coarse skin, short and rounded features, light grey eyes, crisp and curling sandy hair, a short and somewhat ungainly stature, and clubbed fingers, but not uncommonly, as in the former variety, great and early mental activity, and occasionally much muscular strength.

In the dark form of the scrofulous temperament we usually find a somewhat heavy, sullen, and forbidding appearance; a dark, coarse, sallow, or greasy-looking skin; short, thick, and harsh curly hair; a small stature, but often a powerful and strong-limbed frame, with a certain degree of torpor or langor of the mental faculties, though the powers of the intellect are sometimes remarkably developed. The other dark strumous temperament is characterized by clear dark eyes, fine hair, a sallow skin, and by mental and physical organization that pretty closely resembles the first described variety of the fair strumous diathesis.

In all these varieties of temperament the digestive organs will be found to be weak and irritable. This condition, which I believe is invariably associated with struma, and the importance of which has been pointed out by Sir James Clark, must be regarded as one of the most essential conditions connected with scrofula, and as tending greatly to that impairment of nutrition which is so frequent in this state. This gastric irritability is especially characterized by the tongue, even in young children, being habitually coated towards the root with a thick white fur, through which elongated papillæ project, constituting the "pipped" or "strawberry" tongue; the edges and tip, as well as the lips, being usually of a bright red color. This state of the tongue is aggravated by stimulants, high living, and the habitual use of purgatives. In the fair varieties the bowels are usually somewhat loose, but in the dark forms of struma there is a torpid condition of the intestinal canal. In all cases the action of the heart is feeble, the blood is thin and watery, and there is a tendency to coldness, and often to clamminess of the extremities.

One of the most marked characteristics of struma is certainly the peculiar modification that inflammation undergoes, whether we regard the course that it takes, the form that it assumes, its products, or its seat. The course of inflammation in strumous subjects is always slow, feeble, and ill-developed, the more active and sthenic conditions being rarely met with. In its form it is usually congestive, ulcerative, or suppurative, and in its products it is characterized by little tendency to adhesion, by the production of thin, blue, weak, and ill-developed cicatrices, and by the formation of thin, curdy pus, with much shreddy, corpuscular lymph.

The seat of strumous inflammation varies greatly, and peculiar modifications of course, form, and products are assumed, according to the part that it affects. The tissues implicated by it are chiefly the skin and mucous membranes, the joints, and the bones, occasioning a great variety of special diseases, according as one or other of these structures are affected. It is as the result of, or in

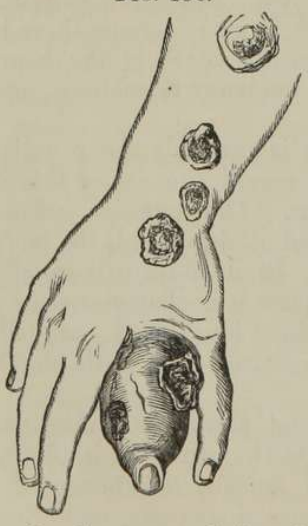
connection with these local affections that the general symptoms of struma become most marked. Whatever the variety of temperament may be, the individual usually emaciates, becomes sallow, cachectic, and debilitated, and at length falls into a state of hectic or marasmus.

When affecting *the skin*, scrofula declares itself under a variety of cutaneous eruptions, especially the different forms of eczema of the scalp, and various ulcers on the surface, usually weak, and largely granulating, with considerable swelling of the surrounding parts, and a tendency to the formation of thin blue and glazed cicatrices (fig. 155). The integuments of the whole of the limb may become so much diseased in this way, œdematous, infiltrated and covered by flabby ulcers and fistulæ, the member being perhaps double its natural size, that amputation is the sole resource. This condition is met with in the arm and foot, and removal of these parts may then be necessary.

Fig 155.

The *mucous membranes* are commonly extensively affected, and often present the earlier forms of scrofulous disease in childhood; this is more especially the case with those of the eyelids and nose. The conjunctiva becomes chronically inflamed, with perhaps ulceration of the cornea. The mucous membrane of the eyelids may be permanently congested and irritated, with loss of lashes, constituting the different form of psorophthalmia. The mucous membrane lining the nostrils becomes chronically congested, red, and swollen, giving rise to habitual sniffing of the nose, and to a sensation as of a constant cold. Occasionally that lining the antrum becomes irritated, and may then occasion an enlargement of this cavity, or the discharge of unhealthy pus into the nostrils. The tonsils are often found chronically enlarged and indurated, with occasional tendency to fresh inflammation; and the larynx may become the seat of various forms of aphonia, dependent on congestion of its lining membrane. The state of the gastro-intestinal mucous membrane has already been described when speaking of the state of the tongue, and that of the genito-urinary organs is also marked by a tendency to debility and irritation, indicated by the occurrence of discharges from the urethra under the influence of very slight exciting causes, and that are often very permanent in their character. The occurrence of calculus of the bladder, especially in children, may also occasionally be attributed to the scrofulous diathesis.

Fig. 156.



Perhaps the most important local diseases arising under the influence of this agency are those of *the bones and joints*. The bones are liable to the occurrence of various forms of caries and necrosis (fig. 156); more especially those that are spongy in their texture, as the short bones of the foot, and the articular ends of long bones. The joints are liable to that large class of affections that are commonly included under the term of *white swelling*, and which consists of thickening, disorganization, ulceration, and suppuration of the synovial membranes and cartilages.

Lastly, some of *the glandular organs* are peculiarly prone to scrofulous dis-

ease. Enlargement of the lymphatic glands, more particularly by the side of the neck and under the angles of the jaw, is of such frequent occurrence, and is usually so early a sign, that the surgeon, in determining whether an individual is scrofulous or not, commonly passes his hand over the glands in this situation in order to ascertain their condition and size; these glandular enlargements are especially apt to run into unhealthy and chronic suppuration. The testes and the mammæ are occasionally affected, and other glandular structures, though sometimes implicated, are by no means so commonly found diseased as those that have just been mentioned.

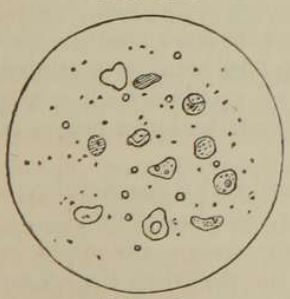
The occurrence of *tubercle* must be looked upon as the great characteristic of scrofula, and when it happens it may be considered a sure sign of this affection, which has then reached its ultimate development. In those cases in which the scrofulous diathesis exist without having given rise to this product, it must be considered as not having been called into full and active operation, having merely manifested itself in the minor forms of disease, such as ulceration of the skin and of the mucous surfaces.

Tubercle, though sufficiently well marked by its appearances and progress, cannot be looked upon as a specific affection, but must be considered to be a perverted or unhealthy development of the nutritive materials destined for the repair of the body and the restoration of the blood. According to Mr. Simon, it consists of a disease of the lymph, or nascent blood. It is a "dead concretion," a "fibriniform product, insusceptible of development." "The scrofulous diathesis," says Mr. Simon, "consists in a peculiarity of blood-development, under which the nascent blood tends to molecular death by superoxydation." According to Dr. Williams, "tubercle is a degraded condition of the nutritive material from which the old textures are renewed, and the new ones formed, and it differs from fibrine or coagulable lymph not in kind, but in degree of vitality and capacity of organization."

Tubercle essentially occurs in two forms, as semi-transparent grey granulations, smooth, and cartilaginous in look, somewhat hard, closely adherent, and accumulated in groups, often with a good deal of inflammatory action in the surrounding tissues. These grey granulations, usually about the size of a small pin's head, appear to consist of modified exudation-matter. They have a tendency to run into masses, and to form the true yellow tubercle, which is met with in opaque, firm, but friable concretions of a dull whitish or yellowish color, homogeneous in structure, and without any appearance of vascularity.

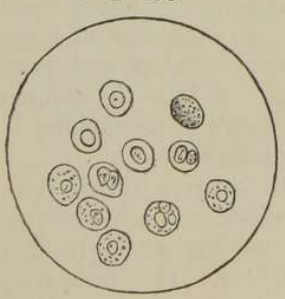
The microscopic characters of tubercle present no very specific appearances (fig. 157). We find that this product presents, under the lens, a homogeneous stroma, which chiefly occurs in the grey granulations; a granular matter, which is principally met with in yellow tubercles; drops of molecular oil; and, lastly,

Fig. 157.



Tubercle.

Fig. 158.



Pus.

considerable quantities of imperfectly developed small exudation-cells, often angular, or broken at one side, more or less disintegrated, stationary, or degraded. Indeed, we must often recognize tubercle by its negative rather

than its positive characters,—by ascertaining what it is not; and so, by a process of exclusion, arriving at its true nature. It is most easily confounded with pus (fig. 158), from which, however, the appearances differ sufficiently to avoid error, if a little care be taken.

The progress of tubercle is most commonly to disintegration and liquefaction, at the same time that it gives rise, by its irritation, to inflammation and suppuration in the surrounding tissues; hence it commonly leads to abscesses, the pus of which is always curdy and shreddy. In some cases, tubercle may become indurated, and undergo a species of calcification.

The *causes* of scrofula, unless this be of a hereditary character, though very various in their nature, are usually such conditions as influence injuriously the nutrition of the body.

The hereditary nature of scrofula is well known both to the public and to the profession; for although the disease is not commonly connate, yet the tendency to it is, and the characteristic nature of the affection often manifests itself at an early period, notwithstanding every effort to prevent its development. That a parent may develop a tendency to mal-nutrition, to mis-development of the blood, just as he may a peculiar feature or mental condition, is undoubted. It is by the hereditary transmission of peculiar combinations and modifications of action in the organization, that hereditary diseases develop themselves at certain periods in the life of the offspring, when the injurious results of the morbid actions that have been transmitted have had time to be produced. There are certain conditions which, though not scrofulous, are supposed to have a tendency to develop this disease in the offspring to which they are transmitted; thus, very dyspeptic parents commonly have strumous children; so, also, the offspring of very old or very young people often exhibit a proneness to scrofulous affections. The influence of intermarriage is still a matter of doubt, but I believe that it exercises little influence in this respect; and it is commonly stated that the inhabitants of small communities who intermarry closely, such as those of the Isles of Portland and of Man, are not more liable to scrofula than other individuals.

The most powerful occasioning cause of scrofula, and that which in most civilized countries is likewise the most frequent, is mal-nutrition, arising either from want of food, or the administration of improper food in the poorer classes; or, from over-feeding and over-stimulation of the digestive organs amongst the children of the wealthier orders of society, thus inducing chronic irritation of the mucous membrane of the stomach, interference with the digestive powers, and consequently with nutrition. The influence of food that is innutritious in quality or insufficient in quantity, has been shown by Mr. Phillips, in his excellent Treatise on Scrofula, to be the most immediate cause of this disease; and when conjoined with the injurious effects of the confined atmosphere of towns, of close and over-crowded rooms, and of want of light and exercise, may be considered as sufficient to occasion the disease in those cases in which no predisposition to it exists, and greatly to develop any hereditary tendency to it in the system. It is to the conjoined influence of agencies such as these that we must attribute the prevalence of scrofula amongst the lower orders of town and rural populations.

Scrofula is often called into immediate action by the debility induced by previous diseases, such as measles, scarlatina, hooping-cough, etc. It usually develops itself at an early age, though seldom before the child has reached its second year. It is most commonly about the period of the second dentition that the affection declares itself, and it is rare to meet with it for the first time after the ages of 25 or 35. According to Phillips, when it is fatal it usually proves so before the fifteenth year; 60 to 70 per cent. of the deaths occurring before this age. Sex does not appear materially to influence the disease, though, according to the same authority, the deaths of males from

scrofula exceed those of females, in this country, by 24 per cent. If, however, we are to regard phthisis as an allied affection, people who are scrofulous in early life often becoming phthisical at a later period, these numbers may require correction.

The *treatment* of scrofula should rather consist in endeavoring to prevent the occurrence or full manifestation of the disease, than in removing it when it is actually existing. Indeed, the preventive treatment is perhaps of most consequence, and by proper attention to it I have no hesitation in saying that the development of the affection, even when hereditary, may be stopped; and the child of strumous parents, presenting perhaps the features indicative of the diathesis, may pass through life without the disease having an opportunity of declaring itself. In order to accomplish this, however, the preventive plan of treatment must be commenced early, and continued uninterruptedly for a considerable time, even for years.

The *preventive treatment* of scrofula may be said in general terms to consist in close and continuous attention to hygienic rules. The diet must be especially attended to, nourishing food, but of the lightest quality, being given. A great error is often committed in overloading the stomach with more or heavier food than it can digest, under the impression that strong food is necessary to give the patient strength. In consequence of this error, the irritability of the mucous membrane is kept up; nutrition is imperfectly and badly performed, the surplus food is thrown off in the shape of lithates or other products of mal-assimilation, and health and strength, which are the results of perfect nutrition, become impaired rather than improved. The use of stimulants, whether wine or beer, should be very sparing, and the milder and weaker should be preferred to the heavier and stronger kinds of malt liquor; the bowels must be kept regular with the simplest aperients; the clothing should be warm, and must cover the whole of the surface, and the patient should if possible be kept in well-ventilated rooms. He should be allowed sufficient exercise in the open air, not carried to the point of fatigue, and should, if his circumstances will permit, have change of air from time to time, alternating a sea with an inland climate. Bathing, also, whether in sea or river, with the habitual use of the tepid or cold sponge-bath, and friction of the surface with horse-hair gloves or a rough towel, so as to keep the skin in healthy action and its cutaneous circulation free, should be regularly practised.

The *curative treatment* should be specially directed, like the preventive, to the general improvement of the nutrition, and through it to the augmentation of the constitutional vigor of the patient; all those hygienic means that have just been alluded to being continuously carried out.

The more strictly medical treatment of scrofula consists in the administration of tonics and alteratives with the view of improving the patient's constitutional powers. Before they are administered, however, it is always necessary to see that the digestive organs are in a healthy condition. Scrofula is a consequence of mal-nutrition, and unless we see that digestion, the first stage of the nutritive process, is properly accomplished, all other means will be useless. When the tongue is covered with a white, thick, creamy fur, having elongated papillæ and red edges, the mucous membrane being in a state partly of irritability and partly of debility, neither purgatives nor tonics can be largely administered; the one irritating, the other over-stimulating the morbidly sensitive mucous membrane. Under these circumstances the patient should be confined to the mildest possible diet, which must principally consist of milk, boiled fish, white meats, and light pudding, no stimulant of any kind being allowed except a small quantity of weak bitter beer; and unless the patient have been accustomed to the use of stimulants, this even had better be dispensed with. Small doses of mercury with chalk, of soda and rhubarb, should be occasionally administered at bed-time, with some of the compound decoction of aloes on the

following morning, and a few grains of the carbonate of soda or potass may then be given twice or thrice a day in some light bitter infusion, as of cascarilla or calumba. In many cases of strumous disease, more especially those affecting the joints and bones, the liver will be found to be enlarged and sluggish in its action, the patient every now and then becoming bilious, sallow and jaundiced; under these circumstances, small doses of bluepill, carried off with the compound decoction of aloes or a rhubarb draught, will be found necessary from time to time. When all gastric irritation has been removed in this way, or if it have not existed in the usual marked degree from the first, the patient being pale and flabby, with a weakened condition of the pulse, of the skin, and of the mucous surface, then tonics may be administered, and the more specific treatment adopted.

The great remedies which are employed with the view of removing scrofula and curing the affections it induces, are iron, iodine, the preparations of potass and cod-liver oil. These are all extremely useful, either singly or conjoined, as they serve to carry out distinct indications in the management of this affection.

Iron is most useful in pale flabby anemic subjects, increasing markedly the quantity and quality of blood in the system. The best preparations for children are, I think, the vinum ferri and the iodide. In older persons the tincture of the sesquichloride, and some of the forms of the citrate of iron, appear to be most serviceable; in other cases, again, the natural chalybeate waters will be found to agree best.

Iodine is especially valuable in promoting the absorption of effused plastic matters, and in lessening the morbid hypertrophies which so commonly take place in scrofula. The preparation usually employed is the iodide of potass. In order that this should produce its full effects, it should be given as freely as the patient will bear it, continued for a considerable length of time, and especially administered in combination with other preparations of potass. With the view of preventing its irritating the stomach, it should be given in a considerable quantity of some bland fluid. Its combination with the other alkalies renders it more efficacious in removing strumous enlargements and deposits of aplastic and tuberculous matter. For this purpose I have found the following form extremely useful for adults, the dose being proportionately diminished in the case of children :—

℞ Potassii iodidi
Potassæ chloratæ āā ʒj
Potassæ bicarbonatis ʒiij.

Divide into twelve powders, of which one is to be taken night and morning in half a pint of warm milk.

In other cases again, the liquor potassæ, Brandish's alkaline solution, or lime water given freely in milk, are serviceable, but I prefer the above prescription. Cod-liver oil is of essential utility in improving the nutrition of the body in cachectic and emaciated states of the system, more particularly in growing children, or in individuals who are suffering from the wasting effects of strumous suppuration; it not only fattens but strengthens the system, increasing decidedly the muscular power and the quantity of red corpuscles in the blood. It may often very advantageously be administered in combination with the iodides of potass or of iron. Of the other tonic remedies which may be employed in this affection, such as the preparations of bark and of sarsaparilla, I need say nothing beyond that they may often be usefully administered in fulfilling ordinary therapeutic indications.

The *local treatment* of scrofula consists in a great measure in the ordinary local management of chronic inflammation, modified according to the seat and particular nature of the affection. Much of the local treatment, however, espe-

cially in the more advanced stages, consists in removing the effects of the disease in the shape of aplastic deposits, false hypertrophies, and general enlargement and thickening of parts. This may usually be done by the application of lotions containing the iodide or the carbonate of potass, applied by means of lint covered with oil silk; ʒj. of each of the salts, with an ounce of spirits of wine to eleven ounces of water makes an excellent application, that appears to dissolve away the fibrinous and plastic deposits so common in this disease. In many cases frictions with the iodide of lead ointment, or pressure by means of strapping and bandages, will be found the most serviceable means that the surgeon can adopt. When matter forms, it should be let out in accordance with the rules laid down in treating of the more chronic forms of abscess. In these cases the injection of the sac of the abscess with a solution of iodine will be found very useful.

In cases of scrofulous disease of the soft parts, the bones, or the joints, the question of the propriety of operating, whether this be for the excision of a tumor, the resection of a joint or bone, or the amputation of a limb, has often to be discussed. In these cases operations should not, I think, be undertaken too hastily, too early in the disease, or especially in very young subjects. The affection being a constitutional one, it will often be found as the general health of the patient improves by proper treatment, that local mischief, which at first appeared of a very intractable character, gradually assumes a more circumscribed and healthy form, and, in fact, to a great extent undergoes spontaneous cure by the restoration of the healthy action in the parts. This we especially find to be the case in young children, in whom very extensive disease of the bones and joints may often be recovered from, without the necessity of any serious surgical interference. Should any operation be undertaken it is desirable not to have recourse to it whilst the disease is actively spreading. Under these circumstances, it is not only probable that suppurative inflammation of an unhealthy kind may be set up in the wound itself, but that disease of the soft parts or bones may very likely recur in the cicatrix of the original wound, or that the corresponding parts on the opposite side of the body may become similarly affected in very chronic cases of scrofulous disease of bones and joints. I have several times observed after excision of the elbow, the knee, or the bones of the foot and wrist, that the morbid action has returned in the contiguous soft parts to such an extent as to render a second operation necessary, although the bones were not implicated, the tissues in the neighborhood of the cicatrix becoming swollen, spongy, and infiltrated with a quantity of gelatinous semi-transparent plastic matter, running into unhealthy suppuration, with fistulous tracts leading through it that could not be brought to heal. In some cases even of simple strumous disease of the integuments of the arm, leg, or foot, attended with great and irregular deposition of plastic matter, and chronic and intractable ulceration, amputation of the limb is the only course left to the surgeon; when strumous suppuration leads to hectic, the patient will speedily sink unless the diseased structures be removed.

CHAPTER XXXI.

SYPHILIS.

By the "venereal disease" is meant any affection that arises from sexual intercourse. It is usually considered to include two distinct specific diseases—Syphilis and Gonorrhea, which were supposed by Hunter and his followers to originate from one and the same poison. But this doctrine is erroneous, for not only are the local appearances and constitutional conditions induced by these affections widely different, but Ricord has shown in the most conclusive manner, that the gonorrheal discharge, when inoculated on the skin or mucous membrane, never under any circumstances produces a chancre; and that on the other hand, chancrous pus can never be made to give rise to a gonorrhea; but that in fact each disease propagates itself, and no other. The two diseases may, however, co-exist, and those cases in which, after connection with the same woman, different men have contracted different forms of the disease, or even both affections, are in all probability to be explained by the fact that Ricord has pointed out, that a woman may be affected by gonorrhea and deep-seated chancres on the uterus, so that although only supposed to be laboring under one, she might easily communicate both or either of these diseases; the true nature of her ailments being only ascertainable by the speculum.

Syphilis[1] is a specific disease, arising from sexual intercourse, and transmissible by the contact of its own specific pus with a tender surface; by inoculation into the system through the medium of the secretions; or by hereditary taint under certain special conditions. It presents two distinct orders of symptoms, the local and the constitutional. The *local* or *primary* symptoms, occurring only on the part to which the virus is immediately applied, and being transmissible solely by direct contact or inoculation; the *constitutional* or *secondary* symptoms, dependent upon the absorption of the poison into the economy, affecting consequently most of the tissues and many of the organs, and being capable of hereditary propagation, and occasionally of transmission through the secretions.

It would be altogether foreign to the scope of this work were I to enter into the general question as to the origin of syphilis, a subject that admits of much dispute, and that has been keenly argued. After an attentive examination of it, I think we cannot fail to come to the conclusion that syphilis was either introduced into Europe, or originated there, towards the end of the fifteenth century; or if it be allowed that it previously existed in the old world, in a mild or modified form, that about this time it suddenly assumed great intensity, all its symptoms being aggravated in a remarkable and fearful manner, presenting characters that have certainly not accompanied it in modern times, if we except the forms that were observed in the British armies during the Peninsular war, and, according to Larrey, among the French troops during Napoleon's German campaigns.

PRIMARY SYPHILIS.

Primary or *local* syphilis is characterized by the presence of specific sores of special forms and appearance, characteristic of the nature of the disease. These may occur on the cutaneous, the muco-cutaneous, and mucous surfaces, most commonly on the latter, on account partly of their greater exposure to

[1] Gonorrhea will be treated of in the chapters on Diseases of the Urinary Organs.

contagion, but chiefly from their being less perfectly protected by epidermis. These local specific ulcers or *chancres* present much variety as to their appearance and the course they pursue; so great indeed are these varieties, that they have been looked upon by some surgeons as affording evidence of their being distinct diseases, proceeding from different poisons. This doctrine, however, has been shown by Hunter, and more recently by Ricord, to be entirely erroneous, the variety in their appearance depending on seat, constitution, and other accidental circumstances. A chancre then is a specific venereal sore or ulcer, originating invariably from contagion, and capable of propagation to other parts of the same or different individuals by inoculation. Like all other ulcers, a chancre presents two distinct periods; the first, in which it is either spreading or stationary, in which alone it is specific, and which may be of almost indefinite duration; and the second, in which it has commenced to granulate, and a process of repair to be set up in it.

Ricord has made the important observation, that if the pus from a chancre, during its first period, be inoculated into any part of the surface of the body, it will invariably produce another specific syphilitic sore or chancre, and that no pus that is not chancrous can, under any circumstances, occasion the specific venereal ulcer. In this way it is always easy to test whether a suspected sore is syphilitic or not. Ricord has further shown that syphilis is always in the first instance a local disease, being confined to the specific sore; and that the constitutional symptoms are only produced by the absorption of the poison from the chancre, which is indeed a truly poisonous ulcer, from which the virus may be absorbed into and disseminated through the whole system.

Chancres almost invariably result from connection with a person laboring under primary syphilitic disease, and hence are commonly met with on the genital organs; in the male, on the glans, the inside of the prepuce, or even the body or root of the penis; in the female, on the external organs of generation or the uterus. They may of course occur in other situations, as, for instance, the fingers of a medical man may be accidentally inoculated by contact with chancrous pus, and they may form on other parts where they have been accidentally or purposely inoculated. Thus I saw some years ago, in Ricord's wards, a man laboring under eczema of the legs, in whom the cutaneous disease had been converted into a series of immense chancres by accidental inoculation from a sore on the penis.

When chancres are caught in connection, they usually commence with a small excoriation, which appears to have been directly inoculated with the specific poison. In other cases, again, though more rarely, they may be seen at first in the shape of a small pointed pustule, which speedily breaks, leaving an ulcer of a specific character in its site. Very generally, however, this pustule escapes observation, and the disease is presented in the first instance as an ulcer. The chancrous ulcer, whatever form it assumes, seldom makes its appearance until a few days, five or six, after connection. In some cases, however, I have observed it, evidently from the infection of a fissure or crack, on the day following impure intercourse, and occasionally, in rare instances, it does not occur until a much later period than that which has been mentioned.

Whatever be the appearances presented by a chancre, there can no longer be any doubt that the disease arises from one kind of virus only, the modifications in the sore depending on its situation, the constitution of the patient, and occasionally on that of the individual who communicates the infection. That this is so, is evident from the fact that every chancre, when inoculated, reverts to one typical form, and that however much chancres may ultimately differ, they all present the same characters during their early stages. The progress of a chancre that has been artificially inoculated on any part of the cutaneous surface is as follows, and its study will serve to elucidate what takes place under other circumstances. During the first twenty-four hours after the introduction of the

specific pus into the skin on the point of a lancet, we find that some inflammation is set up around the puncture, which becomes hot, red, and itchy. About the third or fourth day, a pointed pustule is produced, which is at first deep-set, but becomes on the following day more superficial, with some depression in the centre, resembling pretty closely a small-pox pustule; on close examination, this will be found not to be a true pustule, but rather a mass of epithelial scales and pus not included in a distinct wall. On the fifth day, it has become hard at the base, apparently from the infiltration of plastic matter, and on the sixth it has usually dried, forming a small round scab, and leaving an ulcer which presents the typical characters of a true chancre, being circular and depressed, with a foul greyish surface which cannot be cleansed, sharp cut edges, a hard base, and an angry-looking red areola around it. This is the typical chancre, and these are the appearances that every true syphilitic sore on the skin will present about the fifth or sixth day after inoculation; from this time it may diverge more or less completely from these characters, but will yet, if inoculated at any time during the poisonous stage, produce an ulcer that will run the specific course up to the same period, after which it may in its turn again deviate into one or other of the special forms that chancres occasionally assume. When inoculated on a mucous surface, chancres do not so early assume an indurated character around their base.

The varieties presented by chancres have been described under various denominations by the numerous writers on syphilis. The following classification will, I think, include them all:—1st, the *simple chancre* or *chancrous excoriation;* 2nd, the *indurated* or *Hunterian;* 3rd, the *phagedænic;* and 4th, the *sloughing* chancre.

1st. The *simple chancre*, or *chancrous excoriation*, is certainly that form of the disease which is most commonly met with in London at present. It consists of one or more small sores, of a very shallow character, resembling rather an abrasion, with sharp cut edges, somewhat circular in shape, and having a tawny greyish or yellowish surface, with a narrow red areola around the edge: in many cases attended with much heat and itching. These sores are usually seated on the cleft under the corona glandis, or about the glans, the whole of which may be studded by them. In other cases, they invade the frænum, which may be perforated, or they occupy the mucous surface of the prepuce; in no cases are they indurated in their early stages.

These excoriated chancres not unfrequently present somewhat varying appearances. In some cases their surface becomes covered with large fungous granulations, hence termed *fungating sores.* In other instances, again, they are truly irritable, becoming exceedingly sensitive, with a tendency to spread, and having an areola of a dusky red hue around them. It very frequently happens that these chancres are attended by much general inflammation of the penis, the organ being swollen, red, and semi-transparent, from subcutaneous œdema; usually in a state of phymosis, with a good deal of purulent secretion between the prepuce and glans.

2d. The *indurated* or *true Hunterian chancre*, as it is termed, is not by any means so frequently met with as the last described variety; it may, however, be looked upon as the typical form of chancre, resembling in every respect the inoculated form of the disease. The great characteristic of this form of chancre is the induration of its edges and base, and this character is met with from the very first. Any chancre, but more especially the chancrous excoriation, may during its progress become indurated from undue stimulation, or from being otherwise improperly inflamed, but the Hunterian chancre is indurated from the very first, and continues so throughout. This induration of the base is the result of a peculiar plastic effusion, which, though it resemble microscopically, and chemically, ordinary healthy lymph, yet very distinctly differs from it in its vital characters, just as the pus of a chancre may differ in this respect from that

which is secreted by a healthy ulcer. The great peculiarity of the plastic base of the Hunterian chancre is certainly that it in some way serves as a source for the continued production of the virus and the consequent impregnation of the system with it. Besides the presence of this induration, the Hunterian chancre is characterized by its circular shape, its elevation above the surrounding parts, and the very adherent grey slough that covers its surface. It is usually seated on the glans, but not unfrequently on the skin of the prepuce or of the root of the penis.

3d. The *phagedænic chancre* is characterized by a tendency to erosion, with much destruction of the parts that it invades. It may assume the phagedænic character from the very first, or this may be set up in one of the other varieties of chancre at some period of their course. The progress of this phagedænic or eroding chancre is usually somewhat slow, but continuous; it commonly affects the glans, more especially in the neighborhood of the frænum or urethra, destroying a considerable portion of the organ in this situation. Mr. Wallace has divided this form of chancre into three varieties, that *without slough*, that *with white slough*, and that *with the black slough*. Each of these varieties, again, may be of a *simple*, an *inflamed*, or an *irritable* character. This classification appears to me to be a useful and practical one, and I accordingly adopt it.

The *phagedænic chancre, without slough*, is a truly eroding ulcer, spreading with sharp-cut edges, attended by some slight inflammatory action and with much activity of progress; it is commonly observed about the frænum and under part of the glans, and very frequently hollows out and destroys the organ in this situation to a considerable extent.

In the *phagedænic chancre, with white slough*, we find an irregular eroding ulcer, with a thin margin of white slough situated at the junction of the dead and living structures; that which covers the surface of the sore having usually become darkened by exposure to air, to dressings, and to secretions.

The *phagedænic chancre, with black slough*, differs but little from the last, except in the color of the slough, which may be in a great measure accidental, its tendency to induration, and to somewhat rapid extension; it must not be confounded with the next form of chancre, which presents many points of difference. All these varieties of phagedænic chancre may be inflamed, being attended by much heat, redness, and swelling, increase of discharge and rapidity of action; or they may be irritable, occurring in cachectic individuals, when they are accompanied by much pain, and usually a good deal of constitutional disturbance of a nervous and irritative type.

4th. The *sloughing chancre*, or *gangrenous phagedæna*, is a combination of rapidly spreading and destructive gangrene with the syphilitic poison. It may be looked upon as a gangrenous inflammation of a syphilitic character, and usually affects the prepuce and glans; the parts becoming immensely swollen, red, and somewhat brawny, and the prepuce being in a state of complete and permanent phymosis; a dusky black-looking spot soon makes its appearance on one side of the organ; this rapidly extends, giving rise to thick, black, soft, and pultaceous sloughs, destroying perhaps the whole of the prepuce, and exposing and implicating the glans to a great extent, accompanied sometimes by copious hemorrhage from the dorsal artery of the penis on the separation of the sloughs, and by denudation of the corpora cavernosa. In other cases again, the prepuce sloughs on one side only, a round aperture forming in it, through which the glans projects, giving the organ a very remarkable, and at first sight, somewhat puzzling appearance.

Chancres may be met with on any part of the male genital organs, their characters varying somewhat, however, according to the situation in which they occur. They are by far most commonly seated in the angle formed between the glans and the prepuce; they then appear most frequently at the orifice or on

the inner surface of the prepuce, next on the frænum, then on the glans, and lastly at the orifice of the urethra, or on the skin of the body of the penis. Occasionally chancres are met with on the ends of the fingers, or inside the lips. The situations that specially modify the character of chancres, are the frænum and the orifice of the urethra. Those about the frænum are often sloughy and irritable, have a great tendency to perforate or destroy this fold of mucous membrane, and are more frequently followed by hemorrhage or bubo than any of the other varieties of the disease.

Urethral chancres are usually situated just within the orifice of the canal, and may be seen on pressing open its lips, in the form of a small sloughy sore, which occasionally creeps out upon the glans. Sometimes they are more deeply seated, so as to be out of sight; when this is the case a thick, tenacious, sloughy, and bloody discharge appears in small quantities from the urethra; at a little distance up the canal there will usually be felt, on grasping the organ between the fingers, a circumscribed indurated spot, which is somewhat painful on pressure and after micturition. These chancres have been found by Ricord to extend along the whole of the urethra even to the bladder, and it is their presence in this canal that formerly led to the supposition of the identity of syphilis and gonorrhea, an error the nature of which has been cleared up by the test of inoculation; the discharge from urethral chancres producing the typical sore, that from gonorrhea giving no result when introduced under the skin.

In women, chancres are usually situated on the external organs of generation, most usually just inside the fourchette or labia minora, very rarely indeed on the lining membrane of the vagina, but sometimes on the cervix or os uteri; hence it is impossible ever to pronounce a woman free from syphilis without examining these parts by means of the speculum. When situated upon the external organs, they are not unfrequently concealed between the rugæ, or in nooks and corners of the mucous membrane. In these cases their presence may sometimes be detected by the labia being swollen and œdematous from the irritation of the chancres.

The *diagnosis* of chancres is usually sufficiently easy, the peculiar characters of the sore enabling the surgeon to recognise it in all its forms. In other instances, however, it is by no means easy to say positively whether an ulcer on the penis is or is not of a chancrous character. It is especially difficult to distinguish some forms of excoriated chancre from herpes or aphthæ on the prepuce or glans, or from those slight excoriations that many men habitually contract after a somewhat impure connection; so also the wound resulting from a ruptured frænum often presents a suspicious appearance. In these cases, however, the absence of any specific character about the sore, its immediate occurrence after connection, the general known tendency of the patient to these affections, and the fact of the inguinal glands not being indurated and enlarged, as they are in cases of true chancre, will enable the surgeon to make the diagnosis. When the prepuce is in a state of inflammatory phymosis, it is always extremely difficult to determine by mere examination whether there are chancres under it or not, though their indurated bases may sometimes be felt through it. In the case of the indurated, the phagedænic, or the sloughy chancres, there can be little difficulty in establishing the true nature of the affection. In those cases in which a comparison of the characters of the sore with one or other of the different recognized varieties of chancre failed in enabling the surgeon to determine the true nature of the affection, it was thought at one time that the influence exercised by mercury upon the sore would determine whether the disease was syphilitic or not; the true chancres being supposed to be curable in no other way than by the internal administration of mercury: but although there can be no doubt that the influence exercised by treatment assists the surgeon considerably in the diagnosis of obscure cases, yet it cannot be relied upon as a test of the nature of the disease. many syphilitic affections being

readily curable by very simple means without mercury. The only sure and unerring test that we possess of the nature of a suspicious sore, is the result of the inoculation of its pus into some part of the surface of the body. If this be done with the point of a lancet into the inside of the thigh, the typical chancre will be produced, if the suspected sore be syphilitic, and no effect will result if it be not so. It must be borne in mind, however, that if the ulcer from which the pus is taken has got into a granulating state, no effect may be produced, whatever its previous condition has been; and that if the sore, though of venereal origin, be not a primary syphilitic one, its pus will not be inoculable. Though inoculation is a sure and valuable test of primary syphilis, it should not be too freely had recourse to, as it not uncommonly happens, as I have several times seen, that the sore produced by it is far more troublesome in healing than the original chancre.

TREATMENT OF PRIMARY SYPHILIS.

The treatment of syphilis is a subject that has engaged the anxious attention of the most eminent surgeons, and one on which so much difference of opinion and practice still prevails, that I shall not endeavor to discuss the subject generally, but rather confine my remarks upon it to the consideration of that form of treatment which has met with the sanction of the best surgeons in this country, and which a tolerably extensive experience in hospital and private practice has led me to consider as the most safe and effectual.

The *treatment of chancre* is of a local and a constitutional character, the local treatment having for its object either to destroy the poisonous character of the sore, or to modify it so as to bring it into the state of a healthy ulcer; the constitutional treatment is not only intended to facilitate this, but to prevent, if possible, constitutional infection.

The *local treatment*, then, has for its object either the destruction or the modification of the specific character of the sore. The complete destruction of the local virus should always, if possible, be effected; and if this can be done, in the early stage of the disease, according to Ricord, before the fifth day after inoculation, there will not have been time for any constitutional infection to have taken place from the absorption of the poison into the system. But even though this time have been considerably passed before a surgeon sees the sore, it is well to destroy the ulcerating and poisonous surface, from which continued absorption must necessarily be going on. This should be effected by the application of caustics in a sufficiently concentrated form to destroy radically and at once the specific character of the sore, so as not only to save the pain, but to prevent the irritation attendant upon frequent applications. The nitrate of silver which is commonly used for this purpose is too weak to secure the effect it is intended to accomplish, being apt to irritate and inflame, and not to destroy the chancrous surface, thus necessitating repeated and painful applications. I consequently prefer to this the strong nitric acid, one application of which will very commonly suffice to annihilate the specific character of the sore, and which, though more energetic in action, is not more painful than the nitrate of silver. It should be applied by means of a small dossil of lint wrapped round the end of a silver probe; with this the sore may be freely mopped, and then a stream of cold water having been poured over it to wash away any superfluous acid, a light poultice or a piece of water-dressing should be laid on; after the small slough produced by the caustic has separated, a healthy granulating surface will be left. The caustic may be applied at any time during the continuance of the specific condition of the sore; but when once this has been destroyed, it should not be re-applied. The potassa fusa and the potassa cum calce, though occasionally used, are far less manageable and not more efficacious applications than the nitric acid.

These are the means that are generally most useful in simple and indurated chancres. In some cases, however, caustic cannot be used at once; this is especially the case if the sore be inflamed, or if it be concealed by a phymosis. If there be much inflammation about the sore and prepuce, this must first be subdued by the application of cold poultices, or of lead and spirit lotion. When removed, if the sore has not lost its specific character, the caustic should be applied as usual. When there is much phymosis present, the prepuce should be slit up, and the surface of the sore immediately freely touched with nitric acid, so as if possible to prevent inoculation of the freshly-cut surfaces; should this take place, they must also be freely sponged with the caustic. After the slough produced by the caustic has separated, the surface may begin to granulate healthily at once, requiring but simple dressings; but in the majority of cases it will continue in a somewhat unhealthy condition, requiring special topical applications to get it to cicatrize soundly. If it be weak and fungating, an astringent lotion, such as the following, will be found most useful: —

℞ Tannin ℈j.; Tinct. lavandulæ comp. ʒij.; Vini rubri ℥iv. Ft. lotio.

Or a solution of sulphate of copper may be applied, and the sore touched from time to time with the nitrate of silver. If there be induration at its base, the black or yellow wash will perhaps be found the best applications that can be used.

In the *phagedænic chancres* a different management is required; if there is much irritability about the sore, the nitric acid cannot be borne, and here the best application is an opiate lotion conjoined perhaps with small quantities of the chloride of soda. If the part require more stimulation, a few drops of the dilute nitric acid may advantageously be added instead of the chloride. In these cases, however, the application of the strong nitric acid may often be required at a later period of the affection, on the removal of the local irritation by the topical employment of sedatives.

In *sloughing chancres*, emollient and antiseptic applications will generally be found to agree best; carrot, opiate, charcoal, or chlorinated poultices should be employed, the sloughs removed, and any parts that are partially destroyed by the gangrenous action, as portions of the prepuce, slit up, so as to remove tension and lessen inflammation. In cases of inflammatory sloughing of the penis, the hemorrhage that occasionally results, from some of the blood-vessels of the organ being opened by this action, may be looked upon as highly beneficial, inasmuch as it is often followed by an arrest of the morbid process. When once the chancre is healthily granulating it must be dressed in the same way as any common ulcer. In using lotions to any form of chancre, care should always be taken to keep a piece of lint soaked in the fluid constantly applied between the prepuce and the glans, and, in women, between the opposite labia; for unless this be done, the contact of the diseased and inflamed mucous surfaces with one another will tend to keep up irritation and morbid action.

The *constitutional treatment* of primary syphilis is of the first importance, not so much with a view of getting the local sore to cicatrize, as to prevent, if possible, constitutional infection. As it is impossible to say when the absorption of the poison into the system takes place, though it is probable, as Ricord supposes, that it does not occur before the fifth day, constitutional treatment should be had recourse to from the very commencement of the disease.

The constitutional treatment of primary syphilis has undergone various changes according to the prevailing doctrine of the day. It had been decided by the surgeons of the last and of the early part of this century, that mercury acted as a specific against the syphilitic poison. This doctrine was so firmly established, that Hunter, and many of the great surgeons of his school, looked upon the curability of a sore without mercury as a proof that it was not syphilitic. About the commencement of this century, however, it was found by

the observations of the army surgeons, amongst whom Mr. Rose took a principal share in this inquiry, that the different forms of primary syphilis were curable without the necessity of administering mercury, or indeed to have recourse to any specific treatment whatever. These observations, which appear to have been founded on what was witnessed in Spain and Portugal during the Peninsular War, led to the introduction of an important modification in the treatment of syphilis, viz., the *non-mercurial* or *simple* plan, as it is termed: a mode of practice that obtained great favor, and has been extensively tried. Of late years, however, a reaction has again, I think, taken place in the minds of most professional men, and mercury is again employed in the treatment of this disease, but more moderately and scientifically, and consequently more successfully, than before.

The arguments in favor of the non-mercurial plan of treatment are briefly these: that by this system of treatment the constitution of the patient is saved, the introduction of a mineral which in many cases acts injuriously, and which, as the disease can be cured without it, may at all events be looked upon as unnecessary; then, again, it is stated by the advocates of the simple treatment, that secondary affections less frequently follow this plan than they do the administration of mercury; and, lastly, that those distressing cases of constitutional syphilis, which are common after mercurial courses, and which are said to depend upon a peculiar combination of the syphilitic poison and the mineral in the system, are never met with in persons who have undergone the simple treatment. These arguments, however, on closer examination and further experience, have not been proved to be quite so conclusive as the supporters of the simple treatment appear to believe. That a great number, perhaps the majority, of cases of chancre can be healed without the administration of mercury is undoubtedly the fact; but in many instances it is equally true that the primary sore will not cicatrize properly unless the mineral be administered, or if it do close, that it heals in an imperfect manner, readily breaking out again. But it is a most serious error to confound the healing of the sore with the cure of the disease. The cicatrization of the ulcer and the prevention or neutralization of the constitutional infection, are two distinct things; and the test of the relative value of these two plans of treatment must depend rather on the relative frequency with which they are followed by constitutional symptoms, and on the character that these assume under one or other of these methods, than on the mere skinning over of the ulcer. I cannot agree with the statement that secondary symptoms are less frequent after the simple than after the mercurial treatment of syphilis. I have seen the non-mercurial plan of treatment very extensively employed at the University College Hospital; indeed it was formerly almost invariably practised there, more particularly in the syphilitic cases occurring among the out-patients under the late Mr. Morton, who strongly advocated it; and I have had repeated occasion to observe the frequency with which it was followed by secondary symptoms. In private practice also I have had considerable opportunities of comparing the two methods, and I can safely say that I have seen the simple treatment more frequently followed by secondary symptoms than the mercurial plan has been when properly and judiciously employed. The supporters of the non-mercurial treatment, when obliged to admit the great frequency with which it is followed by secondary symptoms, argue, that if more frequent, they are less severe after the simple than the mercurial plan; and they state somewhat dogmatically, and it appears to me without much evidence to support this statement, that mercury and syphilis together form a sort of poisonous compound in the system which produces the worst and most destructive forms of constitutional syphilis. I deny, however, entirely that we have any proof of the existence of such a combination as that which is supposed to be produced by syphilis and mercury; no evidence that I am acquainted with has ever been

adduced in support of the formation of such a poison in the system. It is doubtless true that after an ill-regulated mercurial course, constitutional syphilis of a very severe character may occasionally appear; but this seems to me to be rather owing to mercury having been improperly administered in constitutions that will not bear it, and in which, by the induction of a cachectic and depraved condition of the system, it favors the occurrence of some of the more severe forms of secondary syphilis, in the same way that any other lowering plan of treatment, or simple debility might occasion them, but without the exercise of any specifically injurious influence. Some of the worst forms of constitutional syphilis that I have of late seen, occurred in patients to whom no mercury had been administered, but in whom the syphilitic virus had been allowed to exercise its influence unchecked save by the so-called simple treatment. I have seen the body covered by immense ecthymatous crusts and sores in one case, rupial ulcers with destruction of the nose and palate in another, and the worst kind of syphilitic cachexy with the tuberculo-pustular syphiloid in a third; in none of which had any mercury been administered. But though I cannot admit that the supporters of the simple treatment of syphilis have brought forward any proof of its superiority over the mercurial plan, and though my own experience has taught me that secondary symptoms occur after it with equal severity and with far greater frequency than they do when mercury is carefully and judiciously administered, yet I am quite ready to allow that there are certain forms of primary sore, especially those of a phagedænic or sloughing kind, in which the simple treatment alone is admissible, the state of the constitution or the disease being such that mercury cannot be given in any form. In these cases the patient must be kept in bed, his bowels properly regulated, and such a treatment adopted, in accordance with ordinary medical principles, as will tend to subdue local action and improve his general condition. It is, indeed, especially in individuals of an unhealthy or strumous habit of body, or in those who are suffering from local visceral disease of some kind, that this plan of treatment should be adopted. So also in those who, from the nature of their occupations, are subjected to much exposure to wet and cold, a mercurial course cannot be properly or safely administered, and the simple treatment is the only plan that should be adopted. In all other cases I am certainly of opinion that mercury ought to be exhibited, and this opinion appears to be entertained by the most experienced surgeons of the day in this country and in France.

The first question in connection with the employment of mercury in syphilis, has reference to the principle on which this remedy is administered. Whether mercury exercises a specific action over the venereal poison or not, has been much discussed, and is difficult of proof. I am certainly of opinion that it does act as a specific in cases of primary syphilis, but that this specific action is much influenced by the condition of the system, the habits of the patient, and the mode of administration of the remedy; these conditions under certain circumstances tending to counteract or otherwise to interfere with its operation. As has already been stated, I do not for a moment doubt that most primary sores may be readily got to cicatrize without administering a grain of mercury to the patient, but I believe that in these cases, and my belief is founded on tolerably extensive experience at the hospital to which I am attached, secondary symptoms will be almost certain to occur, and indeed will appear pretty soon after the cicatrization of the local sore; the disease in fact appearing to contaminate the system unchecked. That mercury in many cases is antagonistic to the syphilitic poison, appears evident from the fact that in some instances chancres will not heal unless it be given internally, — from its influence on infantile syphilis,—and that when properly administered in *healthy constitutions* it may almost to a certainty be looked upon as a preventive to the occurrence of constitutional syphilis. When it fails, as it doubtless does in many cases to prevent,

or to eradicate the constitutional infection, the cause of the non-success may usually be traced either to want of care in its administration, or to the existence of an impaired state of the patient's health.

In connection with the administration of mercury in syphilis, therefore, various questions present themselves, the proper determination of which is of the first importance; these have reference to the state of the constitution, the condition of the sore, and the mode of the administration of the remedy.

The state of the patient's constitution influences materially the propriety of the administration of mercury. In ordinarily healthy constitutions it may always be safely employed; but if the powers of the system be broken by excesses of any kind, if the patient be of a strumous habit of body, if he be irritable, feverish, or excited, it must be exhibited with great caution, or should be withheld until these states of the system are modified or removed. It is especially by administering mercury to strumous and cachectic patients, or to those whose powers have been broken by habitual dissipation, that so much mischief results; and that it occasionally gives rise, by acting as a depressing agent, to local sloughing, or to some of the low forms of secondary syphilis.

The condition of the sore in which mercury should be given, is equally important as that of the health. It should not be administered during the early stage of an inflamed or irritable ulcer. So long, indeed, as such a condition keeps up in the sore, mercury will often act injuriously, by exciting a sloughing tendency in it, more especially in debilitated or broken constitutions; hence it is well to subdue the inflammation or local irritable condition before the mineral is employed.

The particular preparation of mercury to be given, the length of time that it should be continued, and the rules to be observed during the mercurial course, are all matters that influence greatly the result of the treatment.

Mercury may be administered by the mouth, by inunction, or by fumigation. When it is to be given by the mouth in primary syphilis, and when it is desirable to produce but a moderate effect upon the system, I prefer the iodide of mercury, in doses of one grain three times a day; or the Plummer's pill, in five-grain doses twice or three times a day, will be found extremely useful when the constitution is somewhat irritable. If it be desirable to produce a rapid effect upon the system, five grains of blue pill may be given night and morning The other preparations of mercury are not, I think, required in the primary form of the disease. When it is required to produce a moderate effect, especially in somewhat delicate persons, without irritating the system or inducing much salivation, the iodide is certainly to be preferred to all other preparations.

In some cases the bowels are so irritable that the administration of mercury by the mouth invariably purges the patient; under these circumstances the mercurial inunction may be conveniently practised. This is best done by rubbing a drachm of the strong ointment into the inside of each thigh for ten minutes every night and morning; or by putting a similar quantity upon a piece of lint and letting the patient wear it during the day and night in either axilla.

The duration of the mercurial course must depend upon the effect produced upon the sore; it need not be continued until this has cicatrized, but it should be persevered in until all specific action in it has ceased, and it has got into a healthy and healing state. This impression is seldom produced upon the sore without a slight effect upon the mouth having previously been induced, the gums becoming spongy, red, and swollen, and an increased flow of saliva taking place. It is never necessary to continue the mercury so long, or to give it to so great an extent, as to produce very profuse salivation. It was in attempting to do this, and by administering the remedy in too large a quantity and too rapidly, that the older surgeons produced such injurious consequences. The effect produced upon the sore, rather than that upon the gums, should be our guide as to the proper time for discontinuing the mercurial.

The rules to be observed during a course of mercury exercise considerable influence upon the effects produced by it. The system should always be prepared for its administration by a free purge. Whilst it is being given, the patient should, if possible, be kept in bed, or at all events be confined to the house, taking as much rest as possible; the diet should be moderate and unstimulating, and the dress be as warm as the season will admit. If the mercury be given by the mouth, and gripe, it will be found useful to combine it with capsicum. If it purge, small doses of opium may advantageously be exhibited in conjunction with it. After it has been carried to the full extent deemed advisable, it should not be suddenly left off, but gradually discontinued by diminishing the quantity daily during a week or ten days. If administered in accordance with these rules, and in proper constitutions, we shall seldom find any of those injurious effects produced that were formerly described as resulting from the exhibition of this mineral; those severe and extensive forms of ulceration of the mouth leading to necrosis of the jaws, and the mercurial erythema, or erythismus, described by the older surgeons, are now happily almost matters of history, being but seldom if ever met with.

These are the general principles upon which primary syphilis requires to be treated: now for a few words as to the special management of the different forms of chancre

The *simple* or *excoriated chancre* should be cauterized with nitric acid, dressed with water-dressing for two or three days until the slough separates, and then with the black wash, or the sulphate of copper, or tannin and wine lotion if the sore be weak and fungating; in which condition also it will require the occasional application of the nitrate of silver. At the same time the patient should be put upon a mild course of the iodide of mercury.

In the *indurated* or *Hunterian chancre*, the nitric acid may be freely applied in the early stages, so as to destroy the surface of the sore, but no attempt should be made to burn away the indurated base with caustics, as they will prove unsuccessful in this, the indurated condition always extending beyond the influence of the caustic. In these cases the best local application is generally the black wash. It is in this form of sore that mercury is especially useful, and is most imperatively required; a full and continued course should be administered, and the influence of the mineral kept up until all hardness has disappeared; unless this be done, the patient will almost to a certainty suffer early and severely from secondary symptoms.

In the *phagedænic chancres* the line of practice is not so clear, as much must depend upon the particular form of the sore, and the state of the patient's constitution. If there be much inflammation or irritation about the chancre, this must always be subdued in the first instance, by the employment of mild local antiphlogistic means and the application of opiate lotions. In many cases, however, the local inflammatory action is best removed by the application of the concentrated nitric acid, this being followed by opiate lotions or emollient poultices, the caustic being reapplied so often as there is a tendency to the extension of the disease. The constitutional treatment in these phagedænic chancres must usually be of the non-mercurial kind; indeed, it is the indiscriminate use of mercury in these cases that has, I believe, brought so much discredit upon this remedy in syphilis. The constitutional treatment of phagedænic chancre must be directed by general medical principles; rest in bed, a mild diet, the administration of salines and opiates, in those cases in which there is inflammation and irritation conjoined; whilst in those in which there is a debilitated or cachectic condition, tonics, such as bark or iron, with good food and stimulants, may be required, together with opiates to allay pain and to procure rest. The preparations of iron, especially the ammonio-citrate and potassio-tartrate, either alone or in combination with sarsaparilla, are especially useful in these cases. Although mercury is not generally admissible in these cases, yet

in that form of phagedænic chancre that is characterized by a white slough, it has been found useful by Mr. Wallace, and the utility of this practice I can confirm, having found it of service in some of the more rebellious varieties of this disease; the mineral must, however, be very cautiously administered, and in but small doses.

In the *gangrenous* or *sloughing* chancre, if there be much local inflammatory action and general constitutional disturbance, the patient should be treated on an antiphlogistic plan; be well purged, have salines, and in some cases, antimony, kept on a low diet, and have local antiphlogistic treatment. Free incisions should be made through the sloughing textures, so as to take down all tensions, and as the powers of the system give way, or, from the first, if there be much debility, iron, the mineral acids, with quinine, good nourishment and abundant stimulants will be required; at the same time that chlorinated charcoal or yeast poultices are applied locally until the sloughs have separated, when the sore must be dressed on ordinary principles. Hemorrhage not unfrequently occurs from the dorsal arteries of the penis, and sometimes to an alarming extent, the patient being occasionally reduced to the lowest ebb by it. It is best arrested and the morbid action checked by the free application of the actual cautery, and it will usually be found that the hemorrhage has been salutary, the local inflammatory action being at once arrested by it.

After a chancre has been healed in one or other of these ways, we must endeavor to prevent the manifestation of constitutional syphilis, by the general improvement of the patient's health. This is usually best done by putting him on a course of sarsaparilla with the mineral acids, and by scrupulous attention for some months to his habits of life. The syphilitic poison may linger for a great length of time in the system, not declaring itself by any overt manifestations so long as the health continues good, but if the patient fall into a debilitated state, even though some years have elapsed, the disease will show itself at once by some of its local effects.

CONSECUTIVE SYMPTOMS.

The primary symptoms of syphilis are not unfrequently followed by a series of affections which may be termed *consecutive*, depending as they do upon the primary disease, but yet being local in their character, and presenting no evidence of constitutional infection. These consecutive symptoms are, *an induration of the chancrous cicatrix*, *bubo*, and *warts*.

INDURATED CICATRICES. — Most excoriated chancres are healed without any cicatrix or other trace of them being left, but in the indurated, the phagedænic, and the sloughing chancres, there is always loss of substance, often to a considerable extent, and consequently a depressed scar. In some cases, however, of excoriated and Hunterian chancre, but most frequently, I think, in the excoriated chancre, an imperfect cicatrization takes place over the surface of the sore, the specific character of which has not been destroyed; the consequence of which is that the tissue of the cicatrix gradually increases in size, becomes indurated, and is capable of infecting the system. These *indurated cicatrices* are especially apt to follow slight syphilitic excoriations, which may skin over spontaneously, even without the patient having been aware of their existence, or which have cicatrized under simple treatment. Under these circumstances a patient laboring under constitutional syphilis will apply to a surgeon, and on being questioned, may deny having had any primary disease; but on examination an indurated cicatrix will be found, evidently the result of a chancre, that has not been properly attended to.

These indurations vary in size from a pea to a chestnut; they are usually situated on the mucous surface of the prepuce or glans, and sometimes on the

frænum, and are commonly accompanied by an enlarged and indurated condition of the inguinal glands. This indurated cicatrix is a condition of importance, as it shows the persistence of the syphilitis poison in the site of the chancre, where it exists as a continued source of infection to the system, which it may poison as effectually and as quickly as an open chancre, a kind of zymotic action being continued in it, generating and transmitting the syphilitic ferment into the blood. These indurations must be looked upon as infallibly leading to constitutional syphilis unless speedily removed. If left to themselves, they readily break into secondary ulcerations, forming excavated and sloughy sores. On examining their structure, it is found to be composed simply of plastic matter, consisting of the ordinary filaments of this, with spindle-shaped and elongated cells undergoing transformation into fibro-cellular tissue. It is a remarkable fact, that the indurated cicatrix not only always comes on slowly after the sore has apparently healed, but very frequently does not make its appearance until after a lapse of some weeks or months, without inflammation, pain, or local inconvenience of any kind, the surgeon often discovering it without its having attracted the patient's attention.

The *treatment* of this induration must be conducted in the same way as that of a Hunterian chancre, by means of a full and steady course of mercury, until it has wholly disappeared. Unless this be done, there is no safety for the patient from constitutional syphilis. Caustics should never be applied to these indurations, as they occasion troublesome ulcers, and the only local treatment that is likely to be of any service is the application of a piece of lint soaked in black wash, so as to prevent excoriation.

Bubo.—Every enlargement of the inguinal glands that occurs in a case of syphilis must not be considered a bubo. The glands may be irritated by concomitant inflammatory action about the penis, as when balanitis or phymosis are present; or they may be enlarged from the simple excitement of the parts, especially in strumous and debilitated subjects. In these cases the affection must be considered as a simple irritation of the inguinal glands, which will speedily subside under proper antiphlogistic treatment of a mild kind. Indeed, it scarcely ever happens that a chancre has existed for some days without the lymphatic glands in the groin becoming enlarged and somewhat indurated, especially those that lie parallel to Poupart's ligament, their enlargement being attended with a degree of stiffness and dragging pain. Under these circumstances, true specific bubo is very apt to occur if the patient continue to walk about, or if the poisonous matter from the chancre becomes absorbed. When once the glands in the groin have become specifically irritated it is extremely difficult to prevent suppuration taking place. Most usually only one or two glands suppurate, although several may be enlarged, and very commonly the disease is confined to one groin only, though both may be affected, more particularly if the chancre is situated upon the frænum; the suppuration may be limited to the gland immediately affected, or it may extend into the surrounding cellular tissue, or even be chiefly confined to this.

The syphilitic bubo is essentially produced by the absorption and deposit of the venereal virus in the substance of the gland, the tissue of which becomes poisoned, so that we may consider with Ricord that a bubo is, properly speaking, a chancre of an absorbent gland, differing only in seat from that which is situated upon the surface of the body. Ricord has observed, and I have often had an opportunity of testing the correctness of this observation, that the pus of a syphilitic bubo is as readily inoculable as that of an ordinary chancre. The ordinary syphilitic bubo, then, may be considered as a *specific* abscess of the absorbent glands and surrounding cellular tissue. It runs the ordinary course of an acute abscess, often undermines the skin to a considerable extent, with much red or purple discoloration, and when it has burst or been opened, presents a ragged sloughy-looking cavity, having an unhealthy appearance; it most

usually occurs about the second or third week after the first appearance of the chancre, but may happen at an earlier or later period.

The French surgeons have described a form of bubo that they call *bubon d'emblée*, or primary bubo; this is said to occur from the direct absorption of the syphilitic poison without the previous formation of a chancre. It is seldom that satisfactory proof can be given of the existence of such a bubo. It doubtless frequently happens that small excoriated chancres heal in a few days, before which time, however, the inguinal glands have become irritated and enlarged, and as the enlargement of the glands goes on after the healing of the chancre, a bubo may be formed when all trace of its primary source has entirely disappeared.

Bubon d'emblée or *primary bubo*, has only fallen under my observation in one case, and, until that occurred, I doubted its existence. In the case referred to, a young man applied to me with rather a large abscess in the groin, for which I sent him into the hospital, On being questioned, he denied ever having had any syphilitic disease, though he admitted having had intercourse with a woman of the town. On examining the penis no chancre, abrasion, or cicatrix could be discerned. The abscess was opened, and two ounces of rather bloody and very thick pus let out; no enlarged glands could be seen. As the pus looked suspicious, it was inoculated into the left thigh, when two distinct and well marked chancrous pustules were produced.

In some cases the bubo, as has been well shown by Mr. Solly, assumes a tendency to creep or spread over the neighboring integument, extending in this way to a considerable distance down the thigh, upon the abdomen, or over the ilium; this *creeping bubo* is characterized by the peculiar semi-circular or horse-shoe shape that the sore assumes, and by its tendency to cicatrize by one margin whilst it slowly extends by the other, the cicatrix always being thin, blue, and weak, closely resembling that of a burn.

After a bubo has disappeared, a good deal of induration may be left in the glands of the groin, together perhaps with matting of the surrounding cellular tissue, and this induration may continue for years, or even for the remainder of life.

The *treatment* of bubo consists in the first instance of an endeavor to prevent the occurrence of suppuration, and should this take place, to let out the matter and close the wound which results.

The preventive treatment of bubo is of considerable moment; for if suppuration take place, a tedious result will often be entailed on the patient. It consists essentially in perfect rest of the part, the application of leeches, and of cold lead poultices; at the same time the free internal administration of mercury as for a chancre should be persevered in; for not only has this a tendency to promote the resolution of the swelling, but also to prevent the infection of the constitution which readily takes place when once the poison has entered the absorbent system. The employment of antimonials in nauseating doses has been strongly recommended by Mr. Milton, and deserves, I think, the attention of the profession.

If there be not much inflammatory action about the bubo, but if this be indolent and chronic, the application of blisters, of discutient plasters, or of the tincture of iodine, is occasionally useful. A plan of discutient treatment recommended by a French army surgeon, M. Malplaquet, I have found very serviceable in several cases. It consists in applying a blister about as large as half-a-crown over the surface of the inflamed gland, and dressing the raw surface produced by it with a piece of lint soaked in a saturated solution of the bichloride of mercury for a couple of hours, when a white eschar will have formed; a cold poultice should then be applied, and continued until all excited action has gone down.

If, notwithstanding our endeavors to prevent suppuration, matter forms

within or around the gland, as evinced by the swelling becoming soft, boggy, and inflamed, it should be freely opened, either by a horizontal or vertical incision, whichever will give the readiest outlet to the pus. If the integuments be much thinned, undermined, and of a bluish color, I prefer making the opening with potassa fusa, as it destroys those unhealthy tissues which would otherwise interfere with the cicatrization of the wound. The cavity that is now exposed presents a chancrous appearance, being irregular and sloughy, with elevated and angry red edges. This should be dressed with the aromatic wine and tannin lotion, at the same time that the system is kept under the influence of the mercury. If we find that the character of the sore does not improve, the potassa fusa should be freely applied to its surface and edges, and, after the sloughs have separated, the granulations may be dusted with red precipitate powder; the cicatrization will in many cases be much facilitated by the application of a compress, with a spica bandage, and by keeping the patient at rest. Not unfrequently the healing of the sore is interfered with by the overlapping of the undermined edges; these may occasionally be made to retract by being freely rubbed with the nitrate of silver. If this do not succeed, it may be necessary to pare them off with a knife or scissors, or to destroy them with potassa fusa; the sore should then be dressed from the bottom, and treated on general principles. Sometimes sloughing action is set up in the open bubo, and then extensive destruction of tissue may ensue, and even fatal hemorrhage from the femoral artery has been known to occur.

Venereal warts.—Various forms of warts occur as the result of primary disease, independently of any constitutional affection, arising from simple irritation of the muco-cutaneous surfaces; but, besides these, warts or verrucæ of a truly specific and contagious character are met with. These commonly occur on the prepuce or glans, and are especially apt to be situated in the angle between these parts; they are of a bright red color, very vascular, and, if left without interference, may increase immensely in size and number, distending the prepuce, and giving a clubbed appearance to the penis; there is always phymosis attending them, and the tension of the prepuce may be such, that ulceration occasionally takes place in it, giving rise to a protrusion of these growths through an aperture in its side. These warts are occasionally met with in the vagina, forming large, irregular, cauliflower-looking masses. The treatment consists in snipping and paring them off with scissors, and afterwards touching the part from which they spring with nitrate of silver, to prevent their recurrence. In order to do this effectually, it is necessary to lay open the prepuce in all those cases in which the glans cannot be freely exposed by drawing this back.

CONSTITUTIONAL, OR SECONDARY SYPHILIS.

By *constitutional syphilis* is meant the general infection of the system by the venereal poison absorbed from a chancre, by which it is always preceded; in many cases, but not necessarily, a bubo has also been one of the antecedent symptoms. This form of syphilis is commonly called *secondary*, in contradistinction to the primary or local disease. It manifests itself not so much by the occurrence of any special diseases, as by the tendency it occasions to the development of inflammation in various tissues and organs, and by the peculiar impress that it communicates to the form and course of the inflammatory affections it induces.

Constitutional syphilis is not contagious. This point, which I look upon as one of the fundamental doctrines in syphilis, has in my opinion been incontestably proved by the observations of Hunter, and more recently by Ricord, who has shown that the pus from secondary sores is never inoculable; obser-

vations that are fully carried out by what may often be observed in practice. It is, however, hereditarily transmissible from parent to offspring, and conversely it is communicable to the mother from the fœtus in utero.

The period at which constitutional syphilis declares itself usually varies from six weeks to six months after the occurrence of the local disease. Occasionally it shows itself earlier, about the second or third week, when it may be coincident with the existence of primary syphilis; in other cases, again, it does not manifest itself for years after the primary disease. Most commonly its symptoms are progressive, the milder, such as the affections of the skin and mucous membrane, occurring first; the more severe, as those of the bones and organs, afterwards; but in other cases this progression is not observed, symptoms of great intensity setting in early, without being preceded by those of a slighter kind.

When once syphilis has become constitutional, it is extremely difficult to say when it can be eradicated from the system; and indeed it is a question whether it may not impress the constitution in a peculiar way, modifying certain actions during the rest of life, as we know is the case in other specific diseases, such as cow-pox or scarlet fever. Certain it is, that if neglected or improperly treated, it will affect the system for an indefinite time, declaring its existence by exciting and modifying various local inflammations years after the original absorption of the poison. Ricord inclines to the belief that a person who has once had secondary symptoms, and gets well of the constitutional affection, cannot have them a second time, though he contract a fresh chancre; and Mr. E. Wilson attributes many of the ordinary non-specific cutaneous diseases to the latent influence of constitutional syphilis. Without perhaps admitting to their full extent the doctrines of these surgeons, I certainly think that daily experience tends to show that in many constitutions syphilis cannot be eradicated, and that, in most others, when once it has occurred, it is apt, even when apparently cured, to modify certain cutaneous and other affections in a remarkable manner, after the lapse of many years; showing clearly that if the poison no longer exist in the system, the constitution has received a peculiar impress from it, which it is long in losing. These remote effects of syphilis have by Ricord been called "Tertiary." This term is convenient, as indicating a peculiar stage of the constitutional manifestations, in which the tissues are more deeply affected than in the secondary form of the disease.

Although the disease may continue to modify the system for years, or even for life, yet it seldom proves fatal. In some cases, however, death may occur, either by the cachexy that is induced, by the supervention of phthisis, or by caries of the skull, and consequent disease of the brain; fatal and specific syphilitic diseases of the lungs and brain have been spoken of, but I do not think we possess positive evidence of the existence of such affections.

It is especially when the disease has got into the tertiary stage that it runs so protracted and tedious a course. When the syphilitic manifestations are confined to affections of the cutaneous and mucous surfaces, the disease may, and does occasionally, wear itself out, the *materies morbi* being apparently carried off by the secretions of these tissues; and it is only in this way, I believe, that the affection can be eradicated from the system.

That constitutional syphilis is dependent on the absorption of the syphilitic poison into the blood, and its consequent general diffusion through the system, there can be little doubt. Not only is this rendered evident by the great variety of tissues and organs in which it manifests itself locally, but also in the induction of the peculiar syphilitic cachexy. Constitutional syphilis may affect the following tissues and organs, and usually does so in the order in which they are mentioned — viz., the skin, mucous membranes, periosteum, and bones; the throat, tonsils, palate, eyes, nose, larynx, tongue, and testes.

The first occurrence of constitutional syphilis is often ushered in by febrile

symptoms, resembling those of ordinary inflammatory fever, but of rather a low type. In proportion to the severity of these is usually the rapidity of the progress and the extent of the local manifestations.

In other cases again the patient gradually falls into a feeble and emaciated condition, becoming sallow and earthy-looking, with loss of hair, and depression of mental and bodily vigor. In this condition not only are the nutritive functions impaired, as is evidenced by his becoming weak and thin, but the reparative actions are lessened, wounds do not heal kindly, and fractures are slow in uniting.

The syphilitic affections occurring on the skin and mucous membranes are usually of a secondary character, though some belong to the tertiary group; whilst those of the bones and different organs, as the larynx and testes, are commonly tertiary. Although the integumental structures are usually first affected, yet it sometimes happens that the disease manifests itself upon the deeper and more important tissues, without having previously implicated any others.

Constitutional syphilis is not by any means a necessary consequence of the primary disease; many of those affected with chancre escape all after-consequences; in this respect much will depend upon the duration and nature of the primary sore, its treatment, and the state of the patient's health.

That the duration of the local disease influences materially the occurrence of constitutional syphilis, cannot I think be doubted. Ricord states that there is no instance of secondary syphilis occurring if the chancre be destroyed before the fifth day after the inoculation of the poison. This may be so, but the statement appears to me to be scarcely capable of proof, as it is certainly of very rare occurrence for a chancre to be detected and completely destroyed so as to be converted into a simple granulating sore by the fifth day after the infection. It is seldom that it is observed much before this period, and even if it be, no surgeon could be sure of its complete destruction at so early a period after its occurrence. Ricord also appears to incline to the belief that the quantity of pus absorbed from these primary sores destroyed before the fifth day does not influence the nature or severity of the secondary symptoms, and in fact that the patient runs no greater risk from one than from a dozen of them. In this doctrine I cannot agree, for I can see no reason for placing syphilis in a different category to any other animal or vegetable poison, in all of which the constitutional effects are certainly proportioned to the extent of the local infection; at the same time I fully admit that the treatment of the sore and the state of the patient's health influence the severity of the constitutional phenomena to a very considerable extent, and probably, indeed, to a greater degree than any other cause. That the treatment of the primary sore exercises considerable influence, cannot be doubted. The liability to constitutional syphilis is, I believe, materially lessened by a mercurial course, and the severity of the secondary symptoms is not in any way increased if that course be properly conducted. The state of the patient's health also greatly influences the probability of the occurrence of constitutional syphilis. If, after the cure of the primary disease, his health continue good, no infection of the system will manifest itself; but if broken or cachectic, then secondary syphilis will occur cotemporaneously with, or at a very early period after the primary disease; and indeed I generally look upon the chance of the speedy supervention of secondary syphilis as more immediately dependent on this, than on any other cause. It is remarkable for how long a time the syphilitic poison will continue dormant in the constitution without producing any local manifestation of its existence, until this is developed under the influence of a broken state of health. I have at present under my care an extremely severe case of constitutional syphilis, in which twelve years have elapsed since the occurrence of the primary disease, during the whole of which time no secondary affection occurred until the patient's health gave way from other causes. And I have had lately an officer under my care in whom

constitutional syphilis in a very severe form occurred, for the first time, after salivation for hepatic disease, five years after the primary sore had been contracted; no constitutional manifestation declaring itself in the meanwhile. Not only does a state of ill health hasten the occurrence of secondary syphilis, but cachexy, neglect, or indifference to its existence, may keep it up indefinitely.

But not only are the constitutional symptoms influenced by the causes that have just been discussed, they are likewise modified to a considerable extent by the character of the primary sore. Secondary syphilis certainly occurs with far greater frequency and severity after the Hunterian and the phagedænic chancres, than after other forms of the disease. The question as to there being any connection between the nature of the sore, and that of the consecutive constitutional affection, has been much discussed, and though I cannot agree with the doctrine of the plurality of venereal poisons, yet I hold with Carmichael that the different forms of primary sore will, if left to themselves, be followed each by its own peculiar train of constitutional symptoms. In fact I am fully convinced, as the result of much and close observation on this point, that there is a general correspondence between the kind of ulcer and the constitutional syphilis that follows it; both in fact being chiefly dependent upon the state of the patient's health. The same condition of system, for instance, that will give rise to a phagedænic or sloughing chancre, will occasion rupia or ecthyma with necrosis or caries of the bones, as the constitutional manifestations; whereas that which occasions the indurated chancre will equally modify the secondary disease, so that it assumes a squamous form, accompanied perhaps by iritis and osseous disease; and the excoriated chancre will generally be followed by papular or roseolar eruptions, with mucous tubercles on the tongue or throat. That these sequences are of very frequent occurrence, I cannot doubt, having so frequently observed them; and that they are not of constant occurrence is, I believe, owing to the character of the constitutional affection being often modified, by the state of the patient's health having undergone a change subsequent to the cure of the primary sore. Thus a patient having Hunterian chancre, will usually get psoriasis as the secondary cutaneous disease, but let him fall into a cachectic state of health between the healing of the chancre and the supervention of the constitutional affection, and rupia will manifest itself.

In the *treatment* of constitutional syphilis, our object is not so much to relieve or to remove any local morbid condition, as to eradicate a poison from the system; and, indeed, the various local manifestations, more especially those that appear upon the cutaneous and mucous surfaces, may rather be looked upon as efforts of nature for the elimination of the virus from the system through the medium of the great excretory and emunctory organs; and it is often apparently by aiding this natural action by the administration of those remedies that act upon these tissues, that the poison is most effectually eradicated.

During the continuance of the pyrexia, which often ushers in the secondary symptoms, little can be done in the way of specific means for the removal of the disease from the system; rest and mild antiphlogistic treatment being all that can be accomplished during this, the stage of invasion and of constitutional reaction. At a later period, when the cachexy, which is attendant on the disease, has declared itself, attention to the hygienic and dietetic management of the patient is of the utmost importance; a light nourishing diet, often accompanied by the moderate use of wine or beer, and in some of the lower forms of secondary syphilis occurring as the result of phagedænic chancres in broken constitutions, a general tonic plan of treatment, such as the administration of bark, quinine, or iron, and more especially of cod-liver oil, with the mineral acids and sarsaparilla, is required, in combination with the more specific means that we possess, for the eradication of the disease from the system. These remedies must be administered in accordance with general medical

principles, and no special instructions need consequently be laid down for their use here.

The great remedies that we possess for the eradication of the poison from the system are, mercury, and the iodide of potass. Of the value of mercury in constitutional syphilis every surgeon of experience must have had abundant proof. It may admit of doubt whether mercury can be justly considered as exercising a *specific* action in constitutional syphilis, as there are some cases of the disease that it certainly does not appear to influence in a beneficial manner, and others, the severity of which is certainly increased by the administration of this remedy; but it appears to me that in these cases it is rather the patient's constitution which does not bear the remedy well, than the disease that is at fault. We know that in many states of the system, and in many individuals unaffected by syphilis, mercury acts injuriously, more especially when anything like cachexy is present; and we cannot but suppose that the same injurious influence on a particular habit of body must continue, though it be contaminated with the poison of syphilis. The best proof that we possess of the influence of mercury over constitutional syphilis, an influence, indeed, that almost approaches to the nature of a specific action, is in the case of infantile syphilis; here mercury will not only cure the disease, but will eradicate the virus from the system in a way that no other remedy can accomplish.

In the *treatment* of constitutional syphilis with mercury, everything depends on the proper administration of the remedy at a suitable period of the case, and in a fitting condition of the constitution. The question as to the propriety of the administration of mercury in constitutional syphilis, the particular preparation to be used, and the period of the disease in which it should be given, must be determined in a great measure by the previous treatment of the primary disease, by the condition of the patient's general health, and by the duration of the secondary symptoms. If mercury have been freely given, perhaps in repeated, irregular, and ill-conducted courses, for the cure of the primary affection; if the patient have fallen into a cachectic state, having lost flesh, color, appetite, and spirits; if the constitutional affection have assumed the tertiary form, and have deeply implicated the bones, mercury should not be given at all; or, at all events, not without proper previous preparation. Under these circumstances I think we should endeavor, if possible, to remove the constitutional affection without mercury. It is true that in many cases we shall not succeed in doing so, but at least we improve the health, check the disease, and bring the patient into a proper condition to support a mercurial course, should it be thought necessary eventually to put him upon one. It is in these conditions of the system that the nitro-muriatic acid and sarsaparilla are of so much service. From twenty to thirty minims of the dilute acids with half an ounce of the fluid extract of sarsaparilla in four ounces of water, may be administered three times a day. To this, the iodide of potass, in five-grain doses, may often be advantageously added; or, this salt may be given alone in some bitter infusion, as of cascarilla, quassia, or bark; or, if the patient be in a very cachectic and emaciated state, in cod-liver oil. It is in these cases, likewise, that the preparations of iron may be given with so much advantage. When there is great emaciation, I have found the combination of the iodides of potass and of iron with cod-liver oil, to be especially beneficial. But useful as these remedies, especially the iodide of potass and the dilute mineral acids, unquestionably are, more especially when administered in the compound decoction of sarsaparilla, I do not believe that they exercise any specific influence on the disease, or that they do more than relieve or remove local manifestations, often of a troublesome and disfiguring character, failing altogether to cure the constitutional affections and to eradicate the virus from the system, for the removal of which mercury will at last be required. Their great utility appears to consist in removing cachexy, and in restoring the vigor of the

nutritive and reparative actions, which are in abeyance; and, by improving the general tone of the system, in enabling it to resist more effectually the advance of the disease, and, in some cases, perhaps, to allow this to wear itself out. That great advantage results from maintaining the tone of the system in syphilis is undoubted; we always find that the intensity of the ravages of the venereal poison are in direct proportion to the debility and want of resisting power in the constitution of the patient. Besides being useful in this way, these remedies are often of service in removing local affections, and in repairing the injury inflicted upon tissues and organs by the low and specific inflammation that is set up in them. In this respect, indeed, nothing can exceed the value of these remedies in constitutional syphilis. I do not, however, believe that the disease can be eradicated from the system by these means, or that any of these remedies, even the iodide of potass, can take the place of mercury in the treatment of constitutional syphilis; indeed I cannot call to mind a single case in which this form of the affection has been radically and permanently cured without the administration of mercury. Those cases in which they exercise most beneficial influence, are certainly instances in which mercury has been injudiciously administered, either for the primary or the secondary disease, and in which the powers of the constitution have in this way been sapped. Under these circumstances, a course of the iodide of potass, or the mineral acids, in sarsaparilla, should always be administered, with the view of improving the patient's general health.

Looking, therefore, upon mercury as the only remedy we possess that influences directly and permanently the venereal poison, I think that it should always be administered in a full course during some period of the treatment of constitutional syphilis. The time at which it should be given is of considerable importance; thus, it must not be administered until the initiatory pyrexia has subsided under the use of ordinary antiphlogistic treatment; nor should it be given if there is a very marked cachexy. After this has been removed, however, by other means, the exhibition of mercury may be proceeded with.

In administering this remedy for constitutional syphilis, we must not give it largely, so as to affect the system rapidly, but as a mild course for some weeks, so as to act freely upon the secretory and excretory organs, and thus to eliminate the poison from the system. The most useful preparations are the bichloride, in doses from the twelfth to the eighth of a grain; or the iodide, in one-grain doses three times a day. These should be given with sarsaparilla, which keeps up the power of the system and acts freely upon the kidneys and the skin. The mercury should be continued for at least from three to six weeks, until a decided improvement has taken place in the constitutional symptoms. I do not think it desirable to produce salivation; all the good effects of mercury can be obtained far short of this; and indeed if the remedy be pushed to such a point as to affect the mouth or gums, it will commonly act injuriously, by depressing the powers of the system too much. I therefore think it well to suspend its administration whenever an impression has been made upon the disease, and before this effect has been produced. The cautions necessary during the mercurial course, when administered for constitutional syphilis, are precisely similar to those that we have described as necessary during the primary treatment of the disease.

In some cases of constitutional syphilis, affecting the skin and more superficial structures, mercury may conveniently be administered by fumigation. This plan of treatment, which has been especially recommended by Mr. Langston Parker, consists of a combination of vapour bathing and of mercurial fumigation; and this gentleman speaks in the highest terms of the value of this remedy in syphilis, as shortening the duration of ordinary treatment, and permanently curing the disease without the constitution of the patient being in any way injured by its employment. The baths may also be associated with

appropriate internal treatment. During the use of the fumigations, the patient should be dieted, and be put on a full course of sarsaparilla. The bath may be administered every second day, and should consist of about ʒj of cinnabar slowly volatilized by means of a spirit-lamp, at the same time that steam is disengaged from boiling water. In this way I have for some time past used them at the hospital and in private, and with very great success, in cases of syphilitic cachexy with extensive cutaneous disease of an ecthymatous or rupial character, in constitutions in which mercury could not be borne in any more active form.

Whatever plan of treatment be adopted, it should be carried out for a sufficient length of time; great evil often resulting by intercepting it too suddenly, and contenting oneself with the removal of the local mischief, whilst the disease is left firmly seated in the constitution.

Local Secondary Affections.—We shall next proceed to consider the character and treatment of the different *local forms* in which constitutional syphilis manifests itself. These may be considered as they affect different tissues and organs, and require separate consideration, according to the part that is influenced by them. We shall consider them as affecting the skin, the mucous membranes, the mouth, nose, tongue, palate, larynx, testes, and the bones.

The syphilitic affections of the *skin*, *syphilo-dermata*, or *syphilides*, present various modifications of appearance, corresponding pretty closely to the different groups of idiopathic cutaneous diseases; thus we find exanthematous, papular, squamous, vesicular, pustular, and tubercular syphilitic affections of the skin, with various ulcers and growths. These differ from the corresponding simple cutaneous diseases in their redness being more dusky or coppery, in leaving stains of a brownish or purplish hue, in their outline being circular, and in their crusts or scabs being dark, blackish, thick and rugged-looking. Besides this, syphilis modifies materially the general character of the cuticle, causing it to assume a yellow or earthy tint. The worst forms of these affections are commonly met with on the face and more exposed parts of the body.

Syphilitic diseases of the skin arrange themselves under the following groups:—

The *roseolar* consists of blotches of a reddish-brown or coppery tint, which become more distinct as the redness declines; they vary in size from small circular spots to large and diffused patches. These are usually first observed about the abdomen, and commonly occur early in the disease, often before the primary sore is healed. Syphilitic roseola usually follows the chancrous excoriation, and is very frequently accompanied by an erythematous condition of the throat.

The *squamous* syphilide occurs in small patches of an irregular shape, of a red and somewhat coppery color, which are commonly covered with thin filmy scales. In many instances the patches are, however, quite smooth, so as to have a glazed and almost shining look. They are usually situated on the inside of the arms and thighs, often on the scrotum and penis, even occurring on the glans. They also frequently appear on the palms and soles, where deep fissures and cracks are met with. About the lips, the squamous syphilide gives rise to deep and troublesome fissures. It is often associated with a deep and excavated ulcer of the tonsils, with inflammation of the iris, and not uncommonly with disease of the periosteum and bones, and almost invariably follows the indurated chancre. Associated with this condition are large brown patches or maculæ, which occur on various parts of the body.

The *vesicular* syphilide is of very rare occurrence. In one case which fell under my observation, it appeared in the form of clusters of small pointed vesicles, which, on drying, left grey or brownish crusts and coppery marks.

Syphilitic *pustules*, on the contrary, commonly occur; beginning as small hard papulæ of a coppery hue, slowly softening in the centre into a small deep-seated pustule, having a large brown or coppery areola, and forming speedily

large circular dark-brown, or even black scabs; usually flat and irregularly crusted, at other times, conical. When flat, they constitute syphilitic ecthyma; when conical, the rupial form of the disease. After their separation, troublesome ulcers of a circular shape, and with rather a foul surface, are commonly left. This disease first appears upon the face, but speedily shows itself on various parts of the body, more especially on the extremities; it commonly occurs as an early sequence of the phagedænic chancre, and is always indicative of constitutional cachexy; when following other forms of chancre, it is, I believe, owing to the system having in the meantime fallen into a low and broken state.

Syphilitic *tubercles* commonly occur as an advanced or tertiary symptom: they appear as hard, smooth, flat, and elevated bodies, of a reddish brown or purplish color, seated on the face, the tongue, the limbs, the penis, and the uterus. They may be resolved by proper treatment, but have a great tendency to ulcerate and to destroy the parts on which they are situated, giving rise to large, deep, foul, and serpiginous sores.

Syphilitic *boils* of an indolent character, but painful, and discharging a thin ichorous pus, with a core of shreddy cellular tissue, and leaving deep, irregular and foul ulcers, are not uncommonly met with.

Syphilitic *ulcers* may result from pustules, tubercles, or boils, or commence as tertiary sores: they frequently occur where the integuments are thin, or where they are moistened by the natural secretions of the part; they are circular with elevated edges, tend to spread in circles, with a foul, greyish surface; often creeping along slowly, and destroying deeply the parts they affect; leaving cicatrices of a bluish or brown color, thin and smooth, which are apt to break open again on the application of any slight irritation.

The *hair* and *nails* are commonly affected in advanced constitutional syphilis; baldness, constituting *syphilitic alopecia*, occurring either generally or in patches, without any apparent disease of the skin. Disease of the nails, *syphilitic onychia*, occurs in two forms, either as a foul ulceration between the toes, or else as a chronic inflammation, with fetid discharges in the matrix of the nail; which becomes black, more or less bent, and scales off, with the formation of a dirty ulcer under its detached edge.

The *treatment of cutaneous syphilis* must be conducted in accordance with the general principles already laid down, and with special reference to the characters of the concomitant constitutional condition, or of the other local manifestations accompanying it. In the early stages, when ushered in by febrile disturbance, a mild antiphlogistic treatment is required: when the pyrexia has been subdued, more specific measures must be had recourse to. In the *roseolar* forms the treatment of the secondary affection should be guided by the previous management of the primary sore. If mercury have been given for this, we should content ourselves with the iodide of potass in infusion of quassia, or what is better, in full quantities of the decoct. sarsæ. comp. Should mercury not have been given in the primary sore, it must be had recourse to in the secondary affection. In the *squamous* syphilide, mercury, I think, is always necessary, and here I give the preference to the iodide over the other preparations. In the *pustular* forms, syphilitic rupia and ecthyma, the constitution being commonly shattered, a tonic plan of treatment is required in the first instance, after which the bichloride of mercury in tincture of bark or decoction of sarsaparilla should be steadily administered. In these cases also much benefit will be derived by the mercurial fume-bath. In the *tubercular* syphilide much the same treatment is required as in the last variety; in these cases, however, I have often found Donovan's Solution of the greatest possible value, the disease rapidly disappearing under its use; the same plan is required in the management of syphilitic *boils*. In the treatment of secondary syphilitic *ulcers* we shall find it necessary to use caustic freely, with the view of set-

ting up a new and more healthy action in the part. For this purpose nitric acid, or the acid nitrate of mercury, is especially serviceable; on the separation of the slough thus produced, the sore may be dressed with red precipitate powder, or ointment, or the black wash, to which, if there be irritation, opium may be added, the same constitutional treatment, especially Donovan's Solution, being had recourse to. In syphilitic alopecia, the internal administration of the bichloride of mercury with bark or iron, and the external use of a strong stimulant, such as the nitrate of mercury ointment, or the tincture of lytta, will be found most serviceable; and in syphilitic *onychia*, the free application of nitrate of silver, followed by the black wash, and the bichloride of Donovan's Solution internally, is the proper treatment.

Warts, *excrescences*, and *vegetations*, are commonly met with in constitutional syphilis, especially in the neighborhood of the mucous canals, being usually situated in the neighborhood of the anus, the perineum, or scrotum; and in the female, upon and within the labia. They are also very frequently met with about the tongue, on the tonsils, palate, and lips. When occurring in the neighborhood of the organs of generation, they are usually large, flat, soft, and uniform in structure and appearance, with a good deal of mucous exudation, and a sort of perspirable moisture of the neighboring skin. When seated in the mouth or throat they are usually small, and not so distinctly elevated or circumscribed, but look rather like a thickened and opaque condition of the mucous membrane in these situations. These secondary warts, *condylomata* or *mucous tubercles*, as they are often termed, differ essentially from the primary vegetations, not only in their appearance and general uniform character, but in being dependent on the constitutional condition of the disease, and not on local causes solely, such as the irritation of discharges and the want of cleanliness. They are also certainly contagious; and I have known instances in which they have been distinctly transmitted in this way. Their treatment must be constitutional as well as local; the constitutional means should consist in the administration of the bichloride of mercury with sarsaparilla; and the best local treatment that I am acquainted with is to rub them freely with the nitrate of silver, dressing the parts between whiles with chlorinated lotions. Not being pendulous or distinctly protuberant, they do not, like the primary excrescences, require excision.

The *mucous membranes* of the mouth, nose, pharynx, and penis are commonly affected with secondary syphilitic eruptions; these assume the form of mucous tubercles, or of the exanthematous, tubercular, and ulcerative syphilides. The exanthematous affection, corresponding to the roseolar form of cutaneous syphilis, and arising from the same cause and in the same constitution, principally affects the palate and throat. The tubercular variety corresponds to the squamous cutaneous eruptions, and is chiefly met with as flat, hard, and elevated tubercles in the interior of the mouth, nose, and throat. The ulcerative affection of the mucous membranes assumes a variety of forms, which will immediately be described, and occurs principally in the throat and nose. The exanthematous affection of the mucous membrane is usually an early sign of constitutional syphilis, frequently showing itself a few weeks after the primary occurrence of the disease. The other varieties belong to the more advanced secondary or tertiary periods.

The syphilitic affections of the mucous membranes so readily extend to, and are so commonly associated with, corresponding disease of the deeper structures, that we shall more conveniently consider their different forms according as they affect distinct organs or parts of the body.

The *lips* are commonly affected in persons laboring under the squamous syphilide, with fissures or cracks usually somewhat indurated, and very painful in the movements of these parts. The application of a pointed piece of nitrate of silver to the bottom of the crack will give the most effectual relief. The inside of the

cheeks are not unfrequently affected in a similar manner, or become the seat of mucous tubercles, which must be treated as has already been stated.

The *tongue* may be affected with syphilis in various forms; when severely, its disease usually constitutes one of the tertiary varieties of the affection. In many cases the mucous membrane becomes thickened, but preserves a peculiar glossy, semi-transparent, almost gelatinous appearance, and, being irregularly fissured, gives the organ a thick and misshapen look In other instances, again, the epithelium is dry, white and opaque in patches; the surface of the tongue looking as if it had been dyed white here and there. Occasionally, ulcers form upon its surface or sides; these are usually irregular in shape, with a foul surface and a good deal of surrounding induration, and, unless care be taken, may readily be confounded with schirrus or epithelial cancer of the organ. The diagnosis of these affections we shall consider when speaking of diseases of the tongue generally. Occasionally a hard elevated circumscribed tumor of a dark-red or purplish color slowly forms towards the centre of this organ; it increases without pain and in a gradual manner, and principally occasions inconvenience by its bulk and the impediment it occasions in the movements of the tongue. These various diseases indicate a deeply-seated constitutional affection, and require the administration of mercury either in the form of iodide or bichloride. Donovan's Solution is extremely useful in many of these cases. The ulcers should be touched from time to time with the nitrate of silver.

The syphilitic diseases of *the throat* are amongst the most common manifestations of constitutional syphilis, and frequently occur early. They present several distinct forms, corresponding to analogous primary and secondary cutaneous affections. One of the earliest conditions is a deep-red exanthematous efflorescence of the soft palate and the pillars of the fauces, either without ulceration, or with but superficial abrasion, but with much cachexy and depression of power, and perhaps with considerable pyrexia. It often occurs about the period of the invasion of the roseolar or rupial syphilide, and requires the same treatment as is necessary in these affections, together with the local application of a strong solution of the nitrate of silver. A deep excavated ulcer, with a hard base and foul greyish surface, of circular or oval form, is not unfrequently met with on one or other tonsil; it corresponds to that class of secondary phenomena that follows the indurated chancre, and requires mercury in some form for its cure; in this and many other cases the mineral may most conveniently be applied to the throat by means of fumigation. A sloughing ulcer is occasionally seen on the side of the throat or palate, with much swelling, a foul grey surface, and rapid destruction of parts, giving rise very commonly to perforation of the soft palate, and thus, by partially destroying the curtain between the mouth and the nose, occasioning serious inconvenience to the patient during deglutition and in speech. This form of ulcer is connected with the rupial or ecthymatous syphilides, and requires the same constitutional treatment as these. The best local plan is free sponging with strong nitric acid, and gargling with solutions of the chlorides. More rarely a form of the serpiginous ulceration is met with, producing considerable contraction and inconvenient consolidation of tissues after its cure. It is, I think, best treated by the local application of nitric acid, and the internal administration of the bichloride.

The mucous membrane of *the larynx* is not unfrequently affected in advanced syphilis. In these cases chronic inflammation, with thickening and ulceration, takes place about the rima glottidis, with the general and local symptoms of chronic laryngitis; such as huskiness of voice, cough and expectoration of tenacious or offensive mucus; a difficulty in deglutition, and a tendency to choking on swallowing liquids, with tenderness on pressure about the throat, also come on. These cases are usually accompanied by much constitutional cachexy, and not unfrequently eventually terminate fatally by the sudden supervention of œdema glottidis. The constitutional treatment must depend upon the con-

comitant symptoms and the general state of the patient; most commonly tonics will be required. The local means consist in the free application of the solution of the nitrate of silver to the rima glottidis, and the occasional employment of counter-irritation. In syphilitic ulceration occurring about the sides or base of the epiglottis, care must be taken in the application of the stronger escharotics, such as nitric acid, or the acid nitrate of mercury, as a small quantity of these if inhaled into the larynx might produce serious difficulty in breathing or even fatal asphyxia. In many cases it may become necessary to open the windpipe, in order to prevent the patient dying of asphyxia; this must be done in accordance with the rules that will be laid down when treating of chronic laryngitis.

The *nose* is commonly affected in constitutional syphilis, and often destructively so, especially in individuals much exposed to changes of temperature, and who are unable to pay proper attention to their treatment. The mucous membrane becomes chronically thickened, with discharge of blood and pus, coryza, and habitual snuffling. In other cases ulceration takes place, with a very fetid odor of the breath, and the formation of thick ecthymatous crusts on the septum, or between this and the alæ. This ulceration is of a very persistent and troublesome character, and requires usually a mercurial treatment with the local application of strong nitric acid, or of the acid nitrate of mercury, to arrest its progress. In many cases ulceration will rapidly proceed to destruction and perforation of the septum, or necrosis of the spongy bones, the vomer and ethmoid; sometimes excavating the whole of the interior of the nose, scooping and cleaning it out into one vast chasm. When this happens, the nasal bones are usually implicated, being flattened, broken down and destroyed; the alæ and columna ulcerating away, and producing vast disfigurement. Occasionally the disease extends to the bones of the base of the skull, and in this way may occasion amaurosis, epilepsy, or death. The treatment of these nasal affections must be conducted in accordance with general principles. In many cases mercurial fumigation is extremely useful; in others, where the disease is of an ulcerative character, the strong acid and caustic applications already mentioned, with chlorinated solutions occasionally sniffed up, will do much to stop the progress of the disease. As necrosis occurs, the dead bone must be removed.

Diseases of the periosteum and bones are amongst the more remote and severe effects of constitutional syphilis, when it has reached the tertiary stage. They are especially apt to occur in cases in which mercury has been improperly administered, and after the patient has passed through the whole course of the less severe syphilitic affections, such as those of the skin, mucous membrane, and throat. These affections, however, especially of the periosteum, are not necessarily preceded by the minor constitutional effects, but may in some cases declare themselves at the same time that the affections of the skin and mucous membranes do. They more commonly occur amongst the poorer classes, especially those who are exposed to atmospheric vicissitudes, and chiefly in strumous constitutions.

Venereal periostitis or *nodes* may occur in almost any of the bones, but is most commonly met with on the tibia, the clavicle, or the bones of the forearm. Some joints are also not unfrequently affected by it; the sterno-clavicular articulation and knee-joint are especially often the seats of this disease.

Nodes are indolent, elongated, uniform, and hard swellings, sometimes tender on pressure, and generally but little painful during the day, but at night the aggravation of pain is peculiarly marked, and constitutes perhaps the most distressing symptom in these cases. They consist of a thickened state of the periosteum, with some plastic effusion within and underneath it, and occasionally thickening of the subjacent bone; they may continue permanently or may terminate by resolution, it is seldom that they suppurate, unless there be disease of the subjacent bone. The treatment consists, if there is much ten-

derness, in the application of leeches; if there be no great sensibility on pressure, but considerable nocturnal pain, blisters should be applied. When in a chronic state, the tincture of iodine is a useful application. They sometimes become soft and prominent, and feel semi-fluctuating, especially when seated on the cranium, so as almost to tempt the surgeon to make an opening into them; this, however, should never be done, as the swelling, however great, will subside under proper treatment. For the ultimate removal of the tumor, and the relief of the nocturnal pains, we possess an excellent and sure remedy in the iodide of potass.

The venereal affections are principally met with in those bones that are flat and compact, as the cranial, nasal, and maxillary bones. In these, various forms of disease occur. One of the most common is perhaps chronic osteitis, with hypertrophy and condensation of the osseous tissues, often to a very marked extent. This affection may occur in the bones of the skull, but is also met with in some of the long bones, as the tibia and the ulna; it is characterized by very severe pain, especially of a noctural character, accompanying the enlarged and thickened state of the bone.

Syphilitic necrosis chiefly occurs in the bones of the skull and jaws, the alveolar processes of which may exfoliate; the palatine process of the superior maxillary bone, the spongy and the nasal bones, are also commonly destroyed by this morbid action; but it is a remarkable fact that the palate bones are rarely, if ever, affected. In consequence of this destruction of bony tissue, the interior of the nose becomes chronically diseased, the organ may fall in, or a communication be established between the nose and the mouth through the hard palate.

Syphilitic caries, or ulceration of bone, presents different forms, which, according to Mr. Stanley, correspond to analogous ulcers and eruptions of the skin. Thus, there may be the *simple ulcer* of the bone, showing a rough, irregular, porous, and depressed surface; the *worm-eaten caries* consisting of small pits or excavations, studding the surface; and the *serpiginous* or *creeping ulcer*, marked by imperfect attempts at repair, and the deposition of new bone in nodules or masses. The cranial bones are those that are most commonly affected in this way, and their disease may sometimes prove fatal by the irritation set up by it in the brain or its membranes. The bones of the extremities, however, are not unfrequently similarly affected.

The *treatment* of these conditions varies somewhat, according to the form the disease assumes, and the previous management of the patient. In osteitis, the principal reliance should be placed upon the conjoined influence of calomel and opium, provided the patient have not previously been fully mercurialized. If so, our chief reliance must be upon the iodide of potass. In syphilitic necrosis, the constitutional cachexy demands the principal share of attention; the necrosed bone should be separated as it becomes loose, the local irritation depending on its presence then subsiding. When the bone has fallen into a carious state, the iodide of potass, in combination with iron, cod-liver oil, or sarsaparilla, with the mineral acids, will improve the tone of the system, and stay the progress of the disease. The ulcerated and exposed bone requires to be dressed with strong stimulants; the red oxide of mercury, in ointment or powder, is perhaps the best; in some cases, touching the part freely with the acid nitrate of mercury will establish a more healthy action.

Syphilitic iritis commonly follows the indurated chancre, being associated with some of the more advanced secondary sequelæ of that form of the disease. It usually occurs after exposure to cold, and often in people that are otherwise strong and healthy. The ordinary symptoms of iritis, somewhat modified, characterize the affection. The patient complains of dimness of sight, pain in the eye, and often of very severe circumorbital or hemicranial pains. On examining the eye, the conjunctiva will be found slightly injected, and a zone

of pink vessels to be seated on the sclerotic, close to the cornea; the aqueous humor has lost its transparency, giving a muddy look to the eye, and the color of the iris is altered. The pupil is irregular in shape, usually angular towards the nasal side, and small yellowish or brownish nodules of lymph may be seen to be deposited on the surface of the iris. If the case be left to itself, or be improperly treated, it will advance to disorganization or to permanent opacity of the eye. The treatment of these cases consists in local depletion by means of cupping and leeches to the temples, and the administration of calomel and opium internally, at the same time that a drop of the solution of atrophine is put into the eye. Most commonly, as the mouth becomes affected by the mercurial, the eye will clear, the lymph becoming absorbed, and the pupil regaining its normal shape and color. In some cases, however, a chronic inflammation continues; under these circumstances, the best effects result from the administration of small doses of the bichloride, with repeated blistering to the temples, and, in a later stage, soda and bark may be advantageously given.

Syphilitic disease of the *testicle* is one of the more advanced conditions of the constitutional affection. It commonly occurs as the result of that train of symptoms that follows the Hunterian chancre, viz. squamous affections of the skin, the excavated ulcer of the throat, iritis, and nodes, but usually does not appear until these different manifestations of constitutional syphilis have each in their turn passed away; the patient, indeed, appearing to have recovered from all disease, and being otherwise in good health. Commonly, the disease may be referred to a blow, a squeeze, the occurrence of gonorrheal epididymitis, or some other local cause. The testis will then be observed gradually to enlarge, until it attains the size of a turkey's egg, or even larger, being ovoid in shape, heavy, and smooth, not painful except by its weight, which causes dragging and uneasy sensations in the cord and loins. This disease is very commonly accompanied by a small hydrocele, constituting, indeed, a hydro-sarcocele. Most frequently only one testis is affected; it is but very rarely that both are diseased. The affection continues to increase, giving rise to uneasiness from its size and weight, but is not followed by suppuration or other inconvenience.

Mr. Hamilton of Dublin has described another form of syphilitic sarcocele, under the term "tubercular syphilitic sarcocele." In this the testis is enlarged to three or four times its natural bulk, of an irregular shape, presenting an uneven, hard, and knotty mass; it is neither painful nor tender, but inconvenient from its weight, causing pains in the loins and cord. Both testes are usually affected, but one is worse than the other, and when the disorganization is great, Mr. Hamilton states that all sexual desire is lost, and that neither erections nor emissions take place; both, however, returning as the treatment effects the restoration of the organ to its normal condition. In these cases suppuration not unfrequently takes place, followed by the discharge of thin pus, the formation of fistulous openings, and occasionally the protrusion of a fungus. This form of sarcocele occurs in persons of a broken and cachectic constitution, who are suffering severely from the more advanced and inveterate forms of tertiary syphilis, especially of the bones and throat.

In the simple syphilitic sarcocele the enlargement of the testes is principally due to the deposit of semi-transparent white or yellow lymph, in a uniform manner throughout the substance of the organ external to the tubuli. In the tubercular syphilitic sarcocele, Mr. Hamilton states that tubercles of a yellow color, and varying in size from a split pea to a chestnut, or even larger, are found in the substance of the organ; these, softening, give rise to suppuration in and around them, and thus to the ultimate disorganization of the testis, which becomes converted into a hard irregular fibro-cellular mass, in which cretaceous matter is occasionally deposited.

In the *treatment* of the simple form of sarcocele, a full mercurial course is

generally necessary; the bichloride in doses of the twelfth or eighth of a grain three times a day, is the best preparation. This should be continued for at least six or eight weeks, or until hardness disappears. Any hydrocele that exists should be tapped, and the fluid drawn off by means of a small trochar and canula before the treatment is commenced. After the mercury has been discontinued, the remaining swelling of the testis may be got rid of by the internal administration of the iodide of potass, in five-grain doses, twice or thrice daily, with frictions with the iodide of lead ointment. In these cases, care should be taken not to irritate the scrotum with very stimulating applications, as the skin is tender, and readily becomes excoriated; ordinary strapping is of very little use, but in some cases I have found strapping with the emplastrum ammoniaci cum hydrarg., diluted with equal parts of emplast. belladonnæ, of service. If suppuration occur, and a fungus protrude, the same treatment must be adopted as will be described when we come to speak of the strumous testicle.

Besides these various constitutional manifestations of syphilis, tumors of *the muscles and tendons*, depending on this disease, have been described by Mons. Bouisson. These appear to consist of a limited hypertrophy of the tissue of the muscle, with an effusion of plastic matter in its interior. When affecting the tendons, these tumors are elongated, and resemble nodes upon them. Their presence is attended with some pain during the contraction of the muscle; they are usually somewhat globular, and vary in size from a nut to a pigeon's egg, being accompanied by nocturnal pains. They are best treated by the iodide of potass.

INFANTILE SYPHILIS.

The existence of a primary sore on the labia of the mother may possibly infect the child at birth with primary syphilis, just as it might inoculate the hand of the accoucheur; but syphilis thus contracted by the infant is not the form of the disease that is described as "*infantile syphilis.*" This is a truly hereditary infection, transmitted to the infant at the time of its conception, or communicated to it through the medium of the mother during intra-uterine life, and existing as a constitutional affection at the time of its birth. Though we may believe that syphilis is not easily eradicated from a system into which it has once been received, and that under certain conditions it may readily be transmitted to the offspring; yet, I think we are still ignorant of the amount and nature of the constitutional affection of the parents that is necessary for the development of syphilis in their children, and that we are certainly not warranted in concluding that a parent who has been, or even who is actually affected by constitutional syphilis, must necessarily have syphilitic, or even a feeble and strumous family; although the probability undoubtedly is that such will be the case. I have at present under my observation a gentleman whom I had attended for secondary syphilis, and who, contrary to my advice, married a few years ago, and though he has since then suffered from psoriasis of the hands, mucous tubercles, fissures on the lips and tongue, and venereal sarcocele, yet his wife has borne a perfectly healthy family, not only without any syphilitic taint, but without any apparent constitutional cachexy.

Syphilis, when transmitted by the parents, appears to lessen the vitality of the ovum to such a degree, that it either cannot reach its development, or, if it do so, that the child that is born is not only tainted, but enfeebled in constitution. When the ovum is infected with syphilis, several morbid states may result, according to the intensity of the infection. It may be so blighted that it never reaches the maturity of intra-uterine life, but becomes early aborted; in this way many consecutive miscarriages may happen in consequence of one or both of the parents having constitutional syphilis, but if they be put under proper treatment by a mercurial course, and the disease be thus eradicated from the system, the ovum will at the next pregnancy probably reach its full deve-

lopment. The embryo may go its full time, and the fœtus be born with syphilitic cachexy and local manifestations of the disease fully developed upon it. More frequently, however, it happens that the child, although cachectic and sickly-looking, is brought into the world without any syphilitic affection, but in the course of a few weeks, usually from the third to the eighth, these declare themselves. Constitutional syphilis of a congenital nature may manifest itself even at the adult age. This, though rare, has lately fallen under my observation in a young woman of seventeen who was covered with marked syphilitic psoriasis, with which she had been affected for several years. The mother told me that shortly after birth evidences of infantile syphilis had appeared; that these had yielded to treatment, but that as the period of puberty approached, the psoriasis, which was truly of a syphilitic nature, had shown itself. In other cases, again, it is not impossible that the syphilitic taint may manifest itself in a different way than in that which has just been alluded to; that no local manifestation may occur, but that an impaired and depraved state of constitution and of nutritive activity may be inherited, which, in after-life, gives rise to some of the various forms of scrofula, or of other constitutional disease, dependent upon an enfeebled state of system, or a diminution, as it were, of the general vitality.

The mode of communication of syphilis to the ovum, or to the intra-uterine fœtus, is an investigation that has much occupied the attention of surgeons, and is of considerable practical interest. It appears certain that the poison may be communicated to the embryo in at least four ways. Thus, the father may have a constitutional taint of which he has been imperfectly cured, and without communicating any syphilitic disease to his wife, may be the parent of an offspring that exhibits indications of being infected; or, the mother having a similar constitutional disease, may in like manner taint her own offspring; or, again, the diseased child may be born of parents both of whom are constitutionally infected; and, lastly, the mother may become pregnant with a healthy embryo, but afterwards contracting syphilis, may transmit it to her offspring. These points appear to be generally agreed upon by surgeons of experience.

There are several other questions, however, in connection with the transmission of syphilis to and from infants, which are of an intricate character, and have not as yet been cleared up to the satisfaction of all surgeons. Thus, for instance, it has become a question whether a mother pregnant with a syphilitic fœtus, the offspring of a father laboring under constitutional disease, can be infected through it without she herself having had primary syphilis? Ricord states that a woman may be so infected; and Mr. J. Hutchinson has lately advanced a considerable amount of evidence in support of this doctrine. Then, again, the question has arisen whether a wet-nurse laboring under constitutional syphilis can infect the child that she suckles, the infant being contaminated through the medium of the milk. Ricord admits this, but Acton states decidedly that the disease cannot be so transmitted. My own opinion is that it can, though rarely, be so transmitted; and, indeed, there are a number of cases on record in proof of this, in "Ranking's Retrospect," vol. iv. The converse of this is also a matter of dispute, whether a syphilitic child can infect a healthy nurse. This question is one of very great importance, inasmuch as actions for damages have been brought by women who have stated that they have become diseased from the child that they have nursed. Ricord and Acton deny the possibility of this mode of the transmission of syphilis, but there are cases recorded that prove the contrary, and on such a question as this, one positive fact must necessarily outweigh any amount of negative evidence. Not only have Hunter and Lawrence related cases in which an infected child communicated the disease to several nurses in succession; in Hunter's case three wet-nurses were successively infected, two of whom gave the disease again to their own children; but a considerable mass of evidence upon this point is to be found in "Ranking's Retro-

spect," (*Loc. cit.*). The disease is especially apt to be communicated in this way if the nurse have any crack or abrasion upon her nipple, and the infant, sores upon the mouth. Dr. Colles, however, who had great experience in syphilis, states that the disease may be communicated to the nurse from an infected child, by mere contact, without excoriation.

The *symptoms* of infantile syphilis are sufficiently well marked: consisting principally of cachexy, with disease of the mucous and cutaneous surfaces. The first indication is usually the cachectic appearance of the child; this invariably shows itself at birth, syphilitic children being always described as being small, shrivelled, wan, and wasted, when born; the face especially has an aged look, the features being pinched, and the flesh soft and flabby; the complexion generally has a yellowish or earthy tinge, and these characters continue until the disease is eradicated from the system of the child. The first local sign that declares itself is usually a congested condition of the mucous membrane of the nose, giving rise to the secretion of offensive mucus, and causing the child to make a peculiar snuffling noise in breathing, as if it had a chronic catarrh; this snuffling may exist from the time of birth, but generally comes on very shortly afterwards.

The disease manifests itself upon the cutaneous and mucous surfaces, sometimes before or at birth, in other cases not until several weeks have elapsed. The most common period for the occurrence of these signs is the third or fourth week. The cutaneous eruption usually makes its appearance on the nates, the scrotum, the soles of the feet, and around the mouth; hence, on examining a syphilitic child, these parts should always be looked at first. It presents itself in three different forms: most frequently as flat tubercles, varying in size from a split pea to a four-penny piece, smooth, slightly elevated, and of a coppery or reddish-brown color. These tubercles are often accompanied by cracks and fissures about the mouth and anus. Though commonly called *squamous*, they are not in reality scaly, but are always smooth and flat. Intermixed with these are brownish maculæ or spots, differing in size, and variously figured.

The vesicular or bullous eruption is not so common as those just described, but yet I have frequently seen it in syphilitic children. It appears in the form of vesicles, about the size of a split pea, with a dusky coppery areola and base; drying into brown scales or scabs, and commonly conjoined with the tubercular affection. These bullæ are most frequently seen on the soles of the feet.

The *treatment* of infantile syphilis is of a preventive and curative character. Its occurrence in the infant may be prevented by putting the infected mother on a mercurial course so soon as her pregnancy is ascertained; this indeed may be necessary in order to prevent miscarriage, but should be done cautiously, and by inunction, rather than by mercury administered by the mouth. Should repeated miscarriages have occurred, as the consequence of constitutional syphilis, one or other, or both the parents, if at fault, should be put upon a mercurial course, and thus the recurrence of this accident be prevented.

The curative treatment as regards the child is extremely simple. It should be brought up by hand, lest it infect the nurse or continue to receive fresh accession of poison from the diseased milk of its mother. It must then be put under the influence of mercury, which in these cases acts almost as a specific; and indeed the ready manner in which all disease may be eradicated from the system of a syphilitic child by this mineral, is perhaps one of the strongest proofs that can be adduced of the specific character of its action on the venereal poison. The mercury may be given by the mouth in the form of small doses of hydrarg cum cretâ; but as it often purges the child when administered in this way, Sir B. Brodie has recommended its introduction into the system by inunction, in which way I invariably employ it, and have found it a most successful mode of treating the disease. The most convenient plan is, as recommended by Sir Benjamin, to spread ʒi. of mercurial ointment on the under part of a flannel

roller stitched round the thigh just above the knee, and to renew this every day. The treatment should be continued for two or three weeks until all rash and snuffling have disappeared, when the mercury having been discontinued, the cure may be perfected by the administration of small doses of the iodide of potass in milk or cod-liver oil. Occasionally the cutaneous manifestations of infantile syphilis are complicated with, and obscured by some of the common diseases of the skin incident to early childhood; more particularly with eczema impetiginodes of the head, face, and body. Under these circumstances the diagnosis may not be easy, though the history of the case, the concomitant appearance of two forms of the disease, and the existence of snuffling and cachexy, tend to establish it. The eczema also, under these circumstances, is browner and more squamous than usual. In cases such as these, the best plan is to treat the syphilitic affection first with the mercurial inunction, and then to put the child under a mild course of Donovan's Solution, two or three minims for a dose, and keeping it at the same time on a good nourishing diet.

DISEASES OF TISSUES.

CHAPTER XXXII.

SURGICAL AFFECTIONS OF THE SKIN AND ITS APPENDAGES.

THE various specific cutaneous affections, such as eczema, scabies, impetigo, acne, lepra, psoriasis, &c., properly fall within the province of the surgeon, and are commonly treated by him in practice; but as the consideration of these diseases would necessarily lead into the whole subject of Dermatology, the limits of this work would not enable me to discuss so extensive and special a branch of surgery, and I must therefore content myself with the consideration of some of those affections of the skin, which, as requiring manual assistance, may perhaps be more properly looked upon as within the scope of the present Treatise. These diseases may be considered under the several heads of diseases of the appendages of the skin, as of the cuticle and nails; the non-malignant ulcers of the skin, and the malignant ulcers and tumors of this tissue.

Warts and *corns* are affections of the cuticle with which the surgeon may often have to interfere. Warts consist of elongated papillæ, with strata of thickened and hardened cuticle, usually situated about the hands and face, and chiefly affecting young people; they appear in many cases to be simple overgrowths of the cutaneous structures, coming and going without any evident cause. In other cases again they are of a more permanent character, becoming hardened, and dark in color, and continuing perhaps through life. The treatment of these affections is usually sufficiently simple. As their vitality is low, they may be readily destroyed by the application of caustics or astringents; among the most useful of these I have found the concentrated acetic acid and the tincture of the sesqui-chloride of iron. Brodie recommends the solution of ʒi. of arsenious acid in half an ounce of nitric acid. In some cases they may be ligatured or snipped off with advantage.

Corns usually consist of small thickened masses of epidermis accumulated on those points on which undue friction or pressure has been exercised, in order to guard the subjacent cutis from injury. These epidermic masses are usually

hard, dry, and scaly; at other times they are soft and spongy, owing to their being situated in places where the secretions of the skin accumulate, thus keeping them moist. Under old and very thickened corns, it is stated by Brodie that a small bursa is occasionally found. Corns are at all times sufficiently painful, but become especially so if inflammation or suppuration take place underneath them, the accumulation of a small drop of pus under the thickened cuticle, which prevents its escape, giving rise to very intense agony. There is a special form of corn that I have only seen in the sole of the foot, and which may become the source of the greatest possible pain and inconvenience to the patient, preventing his walking, and in fact completely crippling him. This corn is usually of small size and round in shape, the neighboring cuticle being always greatly thickened and hardened. It is extremely sensitive to the touch, the patient shrinking when it is pressed upon, as if an exposed nerve had been injured. On slicing it down with a scalpel, it will be found to be composed of soft, tough, and white epidermis, arranged in tufts or small columns, in the centre of each of which a minute black dot is perceptible. Each tuft appears to be an elongated and thickened papilla, and the black speck is a small point of coagulated blood which has been effused into it. Around the depression in which each of these corns is seated, the hardened cuticle forms a kind of wall.

The *treatment* of ordinary corns consists in shaving or rasping them down so as to prevent the deeper layers of cuticle retained by the indurated superficial ones, giving rise to pain by pressure on the papillæ of the cutis. Relief may also be afforded by removing all pressure from bearing upon the corn, by attention to the shape of the shoe, and by wearing a piece of soft leather or of amadou, having a hole cut in the centre into which the corn projects. It is well to avoid the application of caustics to ordinary corns, injurious consequences being often produced by these agents, especially in elderly people, in whom fatal gangrenous inflammation, as I have seen in one case, may be excited by their action. If the corn suppurate, it must be poulticed and shaved down, and the drop of pus let out by puncture with a lancet. In the painful papillated corn of the sole of the foot I have found the application of potassa fusa, so as to destroy it thoroughly, to be the best and the speediest remedy; and as this corn always occurs in young people, no danger attends its use; or a poultice followed by the application of a blister may bring it away.

DISEASES OF THE NAILS.

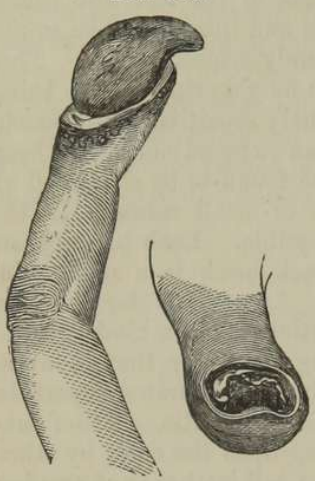
The nails may become diseased, either by undergoing structural changes, by having their matrix inflamed, or by growing into the soft tissues of the toe.

In some broken states of health, and especially in persons suffering from squamous disease of the skin, the nails occasionally become blackish or dark-brown in color, are rugged, dry, and cracked, scaling off, as it were, without any apparent affection of the matrix. This condition, of which I have seen several instances, is best cured by a course of alteratives and sarsaparilla, the disease yielding, as the general health becomes improved.

Onychia is a disease of the nails dependent on inflammation of the matrix; it occurs under two forms, the *simple* and the *specific*. In simple onychia there is redness, heat, and swelling set up, usually on one side of the nail, in the angle of the tissue in which it is implanted; there is no discharge of pus, and the nail gradually loosens, becomes dark-colored, somewhat shrivelled, and may eventually be thrown off, a new nail making its appearance below, which commonly assumes a somewhat thickened and rugged shape. This disease usually results from slight degrees of violence, as the running of thorns and splinters into the finger. The treatment consists in subduing inflammation by local antiphlogistics, poulticing, &c., and watching the growth of the new nail, which may be sometimes usefully directed by the application of a layer of wax.

The *specific* or *malignant onychia* is a more serious affection, and is often dependent on injuries inflicted on the finger in a syphilitic or cachectic condition of the system. In it a dusky-red or livid inflammation takes place at the sides or root of the nail, ulceration is set up, accompanied by the discharge of sanious and very fetid pus, and large loose granulations spring up at its root and sides, so that the end of the toe or finger that is affected, and this is most commonly either the great toe, the thumb, or the index finger, becomes greatly enlarged and bulbous in shape. The nail then shrivels, becomes brown or black, and peels off in strips (fig. 159); after its separation, thick epidermic masses, forming aborted attempts at the production of a new nail, are deposited at the base and sides. In the treatment of this form of onychia, both local and constitutional means are required. The first and most essential point is to remove the nail, either in whole or part, as it acts as a foreign body, and prevents the healing of the surface from which it springs; the ulcer should then be well rubbed with the nitrate of silver, and dressed with black wash. Colles recommends fumigating it with a mercurial candle made by melting ʒi. of cinnabar and ʒij. of white wax together. The constitutional treatment consists of means calculated to improve the general health; with this view Sir A. Cooper recommends calomel and opium. I have generally found the bichloride, with sarsaparilla or bark, the most useful remedy.

Fig. 159.



The *ingrowing of the nail* is an extremely painful and troublesome affection, principally occurring in the great toe, and brought about by wearing pointed shoes, by which the sides of the soft parts of the toe are pressed upon, and made to overlap the edge of the nail. An ulcer here forms, the liability to which is greatly increased by the nail being cut square, so that the flesh presses against a sharp and projecting corner of it; this ulcer secretes a fetid sanious discharge, and large granulations are thrown up by it. The consequence of this condition is lameness and inability to walk or stand with comfort. Various plans of treatment have been devised with a view of raising the edge of the nail, partially removing it, and pressing aside the soft structures. I have never, however, seen much permanent benefit result from any of these means, and the only method that is, I think, really serviceable to the patient, is the removal of the whole nail. As this operation is an excessively painful one, the matrix should be rendered insensible by congelation. It is performed in the following way: the surgeon holds the diseased toe in his left hand, and then running one blade of a strong sharp-pointed pair of scissors under the nail up to its very root, he cuts through its whole length, and removing the scissors, seizes first one half and then the other with a pair of dissecting forceps, and twists them away from their attachments. The raw surface left is covered with water-dressing, and speedily throws out granulations which form the rudiments of a new nail.

TUMORS AND ULCERS OF THE SKIN.

We have already considered the ordinary non-malignant ulcers of the skin (Chap. 24), as well as some of the simple tumors that occur in connection with this tissue; we shall now proceed to the consideration of the more malignant diseases of this structure, such as the cheloid and fibro-vascular tumors, lupus, and cancer.

Cheloid and *fibro-vascular* tumors of the skin are semi-malignant growths situated on the trunk and extremities, usually flat and expanded, oval, round,

or irregular in shape, slightly elevated above the surface of the skin, and commonly occurring in otherwise healthy individuals. They may remain stationary for years, but not uncommonly have a tendency eventually to ulcerate, to bleed, and to assume a sort of malignant action; at other times they extend slowly, without ulceration, moving forwards as it were upon the skin, the part over which they have passed assuming much the appearance of the cicatrix of a burn, being red, contracted, drawn in towards the centre, and wrinkled. Closely allied to these are those fibro-plastic growths that have a tendency to sprout up in scars, constituting the "warty tumor of cicatrices," described by Mr. Hawkins. This morbid condition appears to be simply an abnormal increase in the activity of the development of the cicatricial tissue which springs up with great luxuriance. These various forms of tumor should always be extirpated early by the knife, as they do not appear to be amenable to any constitutional or local treatment, and have certainly a disposition to malignant degeneration. As there is a great tendency to local recurrence of the disease after removal, it should be widely excised, but even then it is likely enough to return, requiring perhaps repeated operations before the patient can be freed from this affection.

LUPUS.

Under the term *lupus*, various semi-malignant and malignant affections of the skin, of very different kinds, are commonly included; indeed, the distinctions between lupus and the different forms of epithelial cancer have not as yet been well made out. There are three forms, at least, in which the diseases included under the term *lupus* may make their appearance. 1st, As a superficial affection of the skin, not attended by ulceration, but accompanied by important and destructive changes in its tissue; this is the *lupus non-exedens* of some writers; 2d, as a slowly ulcerating form of the disease, giving rise to the different varieties of *lupoid ulcer;* and, 3d, the *lupus exedens*, a disease of a rapidly destructive character, not only eroding superficially, but destroying the tissues deeply. These various forms of lupus are most commonly seated on the face or neck, but are occasionally met with on other parts of the body, as upon the limbs or trunk.

Lupus non-exedens appears in the shape of a red patch on the skin, covered by fine, branny, epidermic desquamation; it may remain stationary for years, or slowly spread over a great extent of surface, producing contraction of the skin, with wrinkling and drawing in of the features, and much stiffness in their movements. The integument affected by it may be in one of two states; it may either continue red, irritable, and branny, having the appearance of a thin cicatricial tissue, and in this way the greater part or the whole of the face may be affected; or it may leave a firm, white, smooth, and depressed cicatrix, exactly resembling that produced by a burn, along the anterior margin of which the disease slowly spreads, in the form of an elevated ridge composed of soft bluish-white or reddish tubercles.

The *lupoid ulcer* usually occurs about the face or neck, but sometimes on the extremities of elderly people, or of those in broken health. It may commence as the last described variety, which after a time breaks into an ulcer; or a small crack forms in the first instance, which scabs over, and as this scab separates, the characteristic sore appears. It is in the first case a round or oval flat ulcer, without granulations on its surface and without action in it, with somewhat elevated edges, often stationary, at other times slowly extending; in this way it may continue for months upon the cheeks or neck. In other instances again it spreads more rapidly, attaining a large size, and presenting a somewhat fungating surface, from which some purulent discharge is thrown off. This form of sore I have most commonly seen about the ears and occiput in elderly persons. In other cases again it spreads with great rapidity, giving rise to exten-

sive ravages; thus, I have seen it extend down the whole side of the neck, from the ear to the clavicle, cleanly dissecting away the skin, and exposing the structures immediately subjacent, as the acromial and clavicular branches of the cervical plexus of nerves, and destroying the patient by exhaustion.

The *lupus exedens*, or the more deeply ulcerating form of the disease, may begin in two ways, with or without the existence of a tubercle on the skin. It is most commonly seated on the nose, beginning by ulceration of the mucous or muco-cutaneous surface, without any precursory tubercle, surrounded by redness of a violet or dusky hue, and attended by much inflammation, swelling, pain, and coryza. The ulcer is at first covered by a thick scab; as this separates the sore extends, and often rapidly destroys one or both alæ, the tip and columna; after this the destructive action usually ceases for a time, the sore crusting over with greyish, hard, and adherent scabs, but if not, it may go on eroding one half the face, producing a frightful, rugged-looking cavity, and exposing and destroying the bones and large cavities of the face. I believe, however, that these three forms of disease, that which is limited to the nose, and that which extends widely over and through the face, essentially differ from one another; the first being generally of a scrofulous character, in fact consisting of strumous ulceration is one of the extreme parts of the body, the vitality of which is below its normal standard, and usually occurring in young persons, especially in women from eighteen to twenty-five years of age. Another form of this destructive ulceration is an extensive, deeply-eroding, and fatal disease, affecting the whole of the soft tissues and bones of the face, being distinctly of a cancerous character, and ought not, consequently, to be described as one of the varieties of lupus. The third variety is of syphilitic origin, being one of the most serious forms of tertiary syphilis.

The *strumous* form of lupus exedens, that which destroys merely the extremity of the nose, is commonly rapid in its progress, the part appearing to melt down under the disease, so that in the course of a few weeks the whole of the organ is destroyed. In other cases again it is very slow, occupying perhaps many years, and partaking somewhat of the red and branny form of lupus non-exedens. Occasionally it is evidently associated with and dependent upon the syphilitic taint, and ought then to be considered rather as a variety of local syphilis in a strumous constitution than as a distinct affection.

It is not often that we have an opportunity of examining microscopically the structure of lupus. Some time ago, however, I removed by excision a patch of lupus non-exedens, which had existed for fourteen years under the chin of a woman aged thirty, who was otherwise in good health. On examination it was found to be composed of large cells having clear and very distinct cell-walls, many times larger than blood disks, and well-marked refracting nuclei. There were some cells, clear and globular, without nuclei; others were fusiform and elongated with nuclei, evidently undergoing fibro-plastic transformation (fig. 160). Molecular movement was very distinct in one of these globular cells. The mass of skin appeared to be converted into granular matter, intermixed with these cells.

Fig. 160.

The *diagnosis* of lupus is not always easy, the disease being specially apt to be confounded with some forms of impetigo, with syphilitic tubercles and sores, and with cancer. From impetigo, it may be distinguished by the absence of pustules, and of the thick gummy crusts characteristic of this affection, as well as by the less extent of surface implicated, and the deeper and more eroding form of the lupoid ulceration. From syphilitic disease of the skin, the diagnosis is not always practicable, inasmuch as true lupus may occur as the result of constitutional syphilis. In other cases the history of the affection, the limitation of the disease, and the absence of intervening secondary manifestations, make it easy to distinguish one from the other. From epithelial cancer, lupus cannot in some cases be distinguished, the two affections indeed being closely blended together, and being scarcely recognizable as distinct diseases.

The *treatment* of lupus depends in a great measure upon the variety of the disease with which we have to do, and the constitutional condition attending it, and calls for the employment not only of local but of general remedies.

In *lupus non-exedens* we may, if the disease be limited, excise the patch and heal the sore that results, by granulation. Not unfrequently, however, the cicatrix is apt to undergo fibro-vascular degeneration. If excision be not had recourse to, on account of the extent and superficial character of the disease, it is useless to attempt to destroy it by caustics. In every case in which I have seen these means tried, they have failed in effecting a cure. In some instances, however, the application of a strong solution of the nitrate of silver to the morbid surface will induce a healthier action; though in the majority of instances local applications of a soothing kind can alone be borne. Lotions containing glycerins are especially useful, as they prevent the surface becoming dry and harsh. If the disease be situated on the face, care should be taken to avoid exposure to cold winds, dust, &c. In the constitutional treatment, the avoidance of stimulants of all kinds, the use of a bland diet, and the employment of some of the preparations of arsenic, will be found to be the most likely means to effect a cure. Indeed, arsenic may be considered the great remedy in this disease; the liquor arsenicalis, or the iodide in combination with small doses of the biniodide of mercury, will be found extremely useful; so also Donovan's Solution is most beneficial in many instances.

In the *treatment of the lupoid ulcer*, the same constitutional remedies should be employed as have just been described, and a healthy action induced in the sore by the application of the chloride of zinc paste to the whole of its surface. The best mode of applying this is to keep the chloride prepared for use by being mixed with two or three parts of flour. When wanted, a sufficient quantity of this powder should be made into a stiff paste, by the addition of a little water, and then spread over the surface to be attacked by it, in a layer about the thickness of a wafer; this should be left on for two or three hours, and then removed, the sore being covered with a piece of water-dressing until the greyish slough that has been produced has separated, when the caustic may be re-applied as often as necessary. Besides the chloride of zinc, various other caustics may be had recourse to, each of which possesses some peculiar advantages. The nitric acid is useful, if the action to be produced is not required to be very deep, for as it hardens and coagulates the tissues to which it is applied, it does not consequently extend so far as the chloride. The acid nitrate of mercury presents the same advantage as the nitric acid and other fluid caustics, — that it can be applied into the fissures and hollows of the part into which the more solid caustics do not penetrate, and is certainly useful in inducing a healthy action in the part, especially if there be a syphilitic taint. The potassa fusa and Vienna paste are useful, so far as their destructive properties are concerned, but are somewhat uncontrollable, and apt to spread. The most convenient mode of applying them is to cut a hole in a piece of plaster the exact size and shape of the ulcer, to apply this around its borders, then to cover the sore with

a layer of potassa cum calce, one line in thickness, and over this to lay on another piece of plaster. In this way a considerable amount of caustic action may be induced, which will be limited to the exact surface to which it has been applied. Of all these caustic applications, however, I give the preference to the chloride of zinc; its action is more continuous, and appears to give a healthier stimulus to the part than any of the other agents.

The *treatment of lupus exedens* must have reference to the constitutional condition in which it occurs; if this be of a strumous character, the administration of cod-liver oil and the iodide of potass, with a nourishing diet, will be most serviceable; if in a syphilitic constitution, the remedies that are applicable to the cure of tertiary syphilis, such as the bichloride of mercury and Donovan's Solution, are especially useful. In many cases also in which there can be no suspicion of a syphilitic taint, these preparations of mercury, as well as the iodides of the same metal, may be administered empirically with great advantage. The combination of arsenic, iodine, and mercury that exists in Donovan's Solution, or that is contained in a pill composed of $\frac{1}{6}$ gr. iodide of arsenic and $\frac{1}{12}$ gr. of biniodide of mercury, as recommended by Dr. A. T. Thomson, has appeared to me to be extremely beneficial, and in many cases certainly exercises a marked influence in arresting the disease. Whilst the patient is undergoing a course of these remedies, much attention requires to be paid to diet, clothing, and his general hygienic conditions.

In the local treatment the first thing that requires to be done is to subdue inflammatory action and irritation, by leeches, emollient lotions, and opiate or henbane poultices. As this subsides, the progress of the disease will usually be arrested, for a time at least, and then by the application of the chloride of zinc, or the acid nitrate of mercury to the surface, a more healthy action may be set up, and the sore be got to cicatrize. Great mischief, however, will result if the caustics be applied too early, as the destructive action of the disease will then be augmented. The inflammatory redness and branny desquamation, resembling lupus non-exedens, that surround the ulcer, may usually most readily be made to disappear by the repeated applications of a strong solution of the nitrate of silver, which should be applied every second day by means of a camel-hair brush. The cicatrix that forms in this disease is thin, and breaks readily, giving way on exposure to cold, or on the occurrence of constitutional derangement. The patient should, therefore, for some length of time after recovery, be careful not to expose himself to any such influences. In the more rapidly spreading and worst forms of lupus exedens, that horrible disease termed by the older surgeons, "Noli-me-tangere," nothing can be done beyond the relief that is afforded by the administration of opiates, and a general sedative plan of treatment.

CANCER OF THE SKIN.

Cancer may occur in the skin as a true scirrhous or encephaloid deposit; most commonly, however, those affections of the skin termed cancerous, consist of the epithelial form of the disease, and are usually seated about the lips, face, and scrotum, or at the orifices of the mucous canals; these we have already considered generally, and shall have to revert to them more fully, when treating of the special affections of these parts. Some forms of lupus, also, may be of a cancroid character, but they do not exhibit the true evidence of malignancy by infecting the system, and giving rise to secondary deposits in the different viscera.

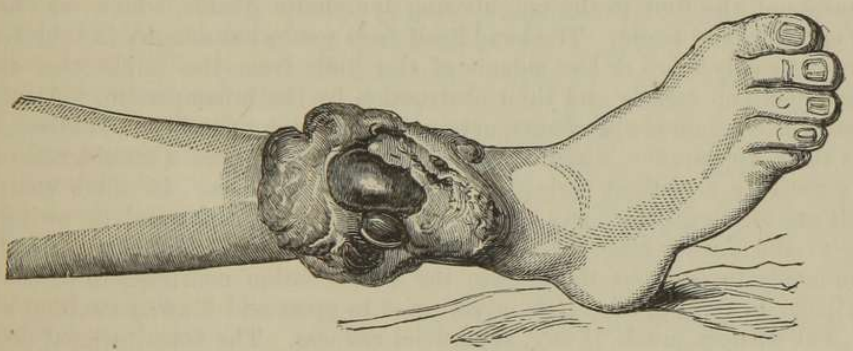
True cancer of the skin may occur in three forms: as the *indurated wart* of a scirrhous character, specially described by Scarpa; as *scirrhous or encephaloid infiltration and fungus;* or as *ulcers* which, primarily originating from some local irritation of a simple kind, may by the persistence of this, assume a truly cancerous character; thus I have seen the scrotum and the neighborhood of

the apertures of fistulæ in perineo, in a case of old standing disease, become converted into a truly cancerous mass.

The *scirrhous wart* is usually of the natural color of the skin, but sometimes of a reddish or dark-greyish hue, hard, and somewhat irregular in shape; it may remain for a long time stationary, but at last ulcerates and spreads rapidly, giving rise to vast destruction of parts; the ulcers formed by it presenting the characters of cancer, with a hard base, everted edges and foul surface.

The *infiltrated cancer* of the skin occurs in the form of a flat dark induration, which scabs over with dark, rugged, greyish-brown incrustations, having shooting pains in and around it, and after remaining stationary perhaps for years, runs into ulceration and rapidly destroys the parts it affects; after ulceration has been set up, the patient's life, according to Dr. Walshe, is seldom prolonged beyond two years. Encephaloid cancer of the skin is of rare occurrence, but occasionally forms large fungating masses sprouting from, and solely connected with, this tissue. The cancerous ulcers of the skin may arise from the irritation and contact of secretions, as of the urine, or an unhealthy and specific action may be set up in an old ulcer, as of the leg, and cause it to assume a cancerous character (fig. 161). These cancerous ulcers may indeed

Fig. 161.



occur upon almost any part of the body: I have seen them on the back, breast, fingers, hand, thigh, and sole of the foot. They are flat, grey or sloughy looking, often with warty granulations, a good deal of induration about them, and but little discharge.

The *treatment* of cutaneous cancer consists in the excision or amputation of the part affected. Its removal by excision, whether in the form of wart, crust, or ulcer, should be effected so soon as its true characters have declared themselves; provided it be of such a size, and so situated, that it can be freely removed with a sufficient stratum of subjacent healthy parts, and a wide border of surrounding skin. Should it be so situated that its excision through surrounding healthy tissue is not practicable, amputation of the limb must be had recourse to, as was done in the case above depicted. Under such circumstances as these, the limb may be removed at no great distance above the disease, it not being necessary, as in other cases of cancer of the extremities where the bones are affected, to allow a joint to intervene between the seat of operation and the malignant growth.

CHAPTER XXXIII.

DISEASES OF THE LYMPHATICS AND THEIR GLANDS.

INFLAMMATION of the lymphatics, *lymphatitis*, *angeioleucitis*, is a diffuse, or erysipeloid inflammation of these vessels. In it, according to Tessier, the lymph coagulates, forming a rosy clot which obstructs the interior of the vessel, the walls of which, at the same time, become thickened, softened, opaque, and surrounded by a quantity of infiltrated cellular tissue.

This disease may be idiopathic, when it is closely associated with erysipelas; but more commonly it is set up from the irritation induced by an abrasion or wound. During the progress of an ordinary injury, the patient is seized with rigors, followed by febrile reaction, and attended, perhaps, by vomiting or diarrhea. These symptoms often precede by twelve or fourteen hours the local signs of the disease, but more commonly accompany them. On examining the part it will, if superficial, be seen to be covered by a multitude of fine red streaks, at first scattered, but gradually approximating to one another, so as to form a distinct band, about an inch in breadth, running from the part affected along the inside of the limb to the neighboring lymphatic glands, which may be felt to be enlarged and tender. The band itself feels somewhat doughy and thickened. There is usually more or less œdema of the limb from the implication of the deeper layers of vessels and their obstruction by the inflammation. Along the course of the inflamed absorbents, erysipelatous looking patches not unfrequently make their appearance, which coalesce until they assume a considerable size, and constitute a distinct variety as it were of erysipelas. In some cases the glands are affected before any other local signs manifest themselves, owing probably to the deeper seated lymphatics having been first implicated; and not uncommonly throughout the disease the inflammation continues to be confined principally to this set of vessels, giving rise to great and brawny swelling of the limb, but without much, if any, superficial redness. The constitutional disturbance at first of the active inflammatory type may gradually subside into the asthenic form.

The disease usually terminates in resolution at the end of eight or ten days, not uncommonly it runs on to erysipelas, and in other cases again, limited suppuration may take place, or a chain of abscesses form along the course of the inflamed absorbents and in the glands to which they lead. In some instances after the disappearance of the disease, a state of chronic and rather solid œdema of the part may be left, giving rise indeed to a species of false hypertrophy of it, and constituting a troublesome after-consequence; more rarely, death results either from erysipelas, by the supervention of pyemia, or by the occurrence of secondary abscesses. This is chiefly in broken constitutions, in which the disease has made extensive ravages, and becomes associated with low cellulitis.

The *diagnosis* of inflammation of the absorbents is easily made; the only affections with which it can be confounded being erysipelas and phlebitis. From the first it may be distinguished by the streaked character, and limited extent of the redness; though as the two affections so commonly occur together the distinction is of little moment. From phlebitis, the disease we are now considering may be recognized by its superficial redness, the inflammation of contiguous glands, and the absence of the knotted, corded state, characteristic of an inflamed vein.

The *causes* of inflammation of the absorbents closely resemble those of erysipelas, the disease being especially disposed to by atmospheric vicissitudes, by particular seasons of the year, more especially the early spring, and by the

epidemic constitution at the time tending to disease of a low type. So also the broken health of the patient and the neglect of hygienic precautions tend to induce it. Amongst the more direct causes are wounds of all kinds, but especially such as are poisoned by the introduction of putrid animal matters or other irritants, or that are of recent origin. It is very rarely indeed, that inflammation of the absorbents occurs without some such cause, but yet I think we are warranted in considering it as of idiopathic origin in some instances. I have at least seen cases in which careful examination has failed in detecting any breach of surface, or evidence of poisonous absorption.

The *treatment* consists in the employment of antiphlogistic remedies, such as the application of a series of leeches along the course of the inflamed absorbents, followed by assiduous poppy fomentations; the limb at the same time being kept elevated. The bowels should be freely opened, and if there be much pyrexia present, salines with antimony may be administered. If the fever assume rather a low form, the liquor ammoniæ acetatis may be given in camphor mixture; support being administered, or withheld, in accordance with the principles laid down when speaking of the treatment of inflammation generally. If chronic induration and œdema occur, the application of blisters will be found to be of use in taking down the swelling and hardness; bandaging so as to compress the limb methodically, may be of service in the later stages. If abscesses form, these should be opened early, and treated on ordinary principles.

Inflammation of the lymphatic glands, or *adenitis*, may occur either by the extension of inflammation along the course of the lymphatics, by the irritation induced by acrid or poisonous substances conveyed along these vessels, and not inflaming them, but inducing diseased action in the glands through which they are carried; or as a consequence of strains resulting from over-exertion, as is often seen in the glands of the groin from walking too much. In whatever way occurring, inflammation of the absorbent glands is always attended by a stasis of the lymph, by coagulation of it, and, if the whole or greater part of the glands of a limb are affected, the course of the fluid through the absorbent vessels may be so seriously interfered with, that œdema, often of a solid character, occurs in the lower parts from which the lymph ought to have been conveyed.

Adenitis may be acute, subacute, or chronic. In the acute form of the disease, which almost invariably occurs as a consequence of angeioleucitis, there is pain, swelling, tenderness, and stiffness about the affected glands, with a dull heavy sensation in them, followed by all the signs of acute abscess, the glands gradually softening in the centre, and the suppurative inflammation extending to the contiguous cellular membrane, through which it becomes somewhat diffused. In the subacute inflammation, which is of common occurrence as the result of injuries or strains, the glands become swollen, enlarged, and tender, and are matted together by the inflammatory and plastic consolidation of the neighboring tissues. If abscess form, it commonly commences in the first instance in the structures around the glands, and these are perhaps eventually exposed at the bottom of the cavity that results. This is especially apt to happen in cachectic and strumous persons, from slight sources of irritation. Very commonly, in such subjects as these, the inflammation of the glands runs into a chronic state; which, indeed, may at last terminate in their permanent enlargement and induration, or tuberculous degeneration. When the glands become chronically inflamed from the first, they will be found to be enlarged and hardened, with tenderness and pain about them; after a time suppuration takes place within them, or perhaps it may occur in the cellular tissue around them, which, breaking down, leaves them in the form of reddish-grey or fleshy masses, that protrude in the midst of the suppurating cavity; as the inflammation subsides, the skin becomes of a reddish-blue or purple hue, is thinned, and firmly incorporated with the subjacent tissues.

But the glands not uncommonly enlarge chronically without any inflammation, simply as the result of strumous disease or of chronic irritation of some kind. They may remain permanently enlarged, or, after continuing so for months or years, may slowly break down into unhealthy suppuration, leaving the skin thin, blue, and undermined, with weak and often protuberant cicatrices. The pus discharged from these strumous glands is of a curdy, ill-conditioned character. In all probability the peculiar enlargement and tendency to unhealthy suppuration arise from the deposit of tuberculous matter within the gland. These changes principally occur in the neck, especially in the submaxillary glands, and the glandulæ concatenatæ, sometimes in the axillary or inguinal glands, forming large indurated and nodulated tumors, matted together, and suppurating in the interstices of the cellular tissue, or in the substance of the glands themselves. This strumous enlargement of the glands occurs chiefly in children and in young people, in whom indeed it is commonly looked upon as one of the most frequent accompaniments of the strumous diathesis.

The *treatment* of inflamed absorbent glands varies of course greatly, according to the stage of the affection. In the acute stages, leeches and fomentations are especially required. In the subacute condition, spirit-lotions containing the iodide of potass will subdue the inflammation and take down the swelling; at the same time the health must be regulated by aperients, and a moderate antiphlogistic plan of treatment. If abscess forms, this must be opened with a knife, and the part well poulticed afterwards; the fistulous openings which are often left require to be treated by stimulating applications, especially the nitrate of silver, but very commonly they will not heal unless they are slit up and dressed from the bottom.

The chronic inflammation or enlargement of the lymphatic glands, or the induration left as the result of the acute disease, requires to be treated on different principles. If there be any pain and tenderness about them, the application of the iodide and spirit-lotion will be required. If they have already suppurated, and an aperture exist leading down to an indurated mass, or if there be surrounding induration of the soft tissues, it is often a good plan to rub the ulcerated part freely with caustic potass, which will dissolve it away by exciting inflammation around the plastic deposit, and thus causing its dissolution into pus. When merely chronically enlarged, without being irritated, methodical friction with the iodine or iodide of lead ointment will produce absorption of the inflammatory effusion constituting the bulk of the enlargement, and this in many instances may remove the tumor entirely. In other cases, again, painting the part with the tincture of iodine, and improvement of the general health, will cause the removal of the diseased structure. After abscess has formed and been opened, fistulous openings will be left, into which large masses of hypertrophied gland may be seen to project. These are best reduced with the red oxide of mercury, or potassa fusa; indeed, if the glands be much enlarged and indurated, projecting into the openings made over them, the potassa fusa is the best application that can be made use of, breaking down and dissolving away the indurated mass. In applying it, care must be taken that the caustic does not spread too widely; this may usually be avoided by coating the surrounding integuments with collodion. Extirpation of enlarged lymphatic glands is seldom necessary, and if undertaken may lead to more serious and extensive dissections than might appear at first requisite, a chain of diseased glands often extending to a considerable distance—after one has been removed others coming in sight. As a general rule, these operations should not be undertaken; cases, however, occasionally occur, in which such a procedure may be deemed advisable, the affected glands being large, indurated, and tuberculous, and their disease of many years' standing; under such circumstances, their extirpation may be proper, and I have not unfrequently had occasion,

under such circumstances, to remove them from the axilla, sub-maxillary region, and the posterior triangles of the neck.

The lymphatic glands occasionally become much enlarged in the neck, axilla, or groin, without any indications of struma, but attended by much debility, and usually great emaciation; under these circumstances, the best remedies are the liquor potassæ in full doses, and cod-liver oil.

Besides these inflammatory and strumous enlargements of the lymphatic glands, various other alterations are frequently observed in them; thus, they may undergo cancerous degeneration, as the result of absorption from a scirrhous, melanotic, or encephaloid tumor. In other cases, again, they have been found to have undergone calcification, as the result of tuberculous degeneration; and, lastly, a varicose condition of the absorbent vessels that pass through them has been observed by Amussat and Breschet, but these are rather matters of pathological than of practical interest.

CHAPTER XXXIV.

DISEASES OF VEINS.

PHLEBITIS.

Inflammation of the veins, originally studied by Hunter, has of late years attracted the attention of many distinguished Continental and British pathologists, amongst whom may be specially mentioned Breschet, Velpeau, Cruveilheir, Arnott, Lee, and Tessier. This disease is commonly excited by the wound of veins, as in operations, venesection, and injuries of various kinds; or it may result from the application of ligatures to them, and is especially predisposed to by a previously unhealthy condition of the vessel, and by epidemic constitution and season; in fact, by those influences that dispose generally to the diffuse forms of inflammation.

When a vein is inflamed, important changes occur both in the coats of the vessel and in the contained blood. The coats of the vessel generally become thickened, the outer one especially being vascular and infiltrated; the inner coat becomes softened, pulpy, and usually more or less stained by the coloring matter of the blood of a dark-red or purple hue. The blood in the inflamed vessels undergoes coagulation, and adheres to their sides; this tendency to adhesion and coagulation being increased by the effusion of plastic matter from the wall of the vessel. As a consequence of this, its interior becomes stuffed with a solid mass of coagulated blood and lymph. This coagulatian of the blood in the interior of the inflamed vein is a very remarkable circumstance, and appears to be specially induced by the morbid action going on in the coats of the vessel, though in many cases it is doubtless aided by the blood becoming entangled in the plastic matter with which the lining membrane of the vein speedily becomes coated. Suppuration often takes place in the interior of the vein, the pus being produced not by the transformation of the contained blood, but by effusion from the coats of the vessel. These changes may occur in any vein, external or internal, and we often find them associated; the same vessel containing a mixture of coagulum, fibrine, and pus. The extent of surface which the inflammation may occupy varies from that of a small vessel a few inches in length, to the trunk and branches of one of the largest veins in the

body. In accordance with these pathological conditions, three varieties of phlebitis may be described — the *adhesive*, the *suppurative*, and the *diffuse*.

In the *adhesive phlebitis*, plastic matter is thrown out by the wall of the vein, and the blood coagulating upon and in this, a firm plug is formed, by which the vessel is more or less completely obstructed. This obstruction of the vessel which is the common result of this form of the disease, may continue permanently, the plug becoming incorporated with its coats, and gradually undergoing fibro-cellular degeneration it is converted into an impervious cord. In other cases again, a channel eventually forms through the axis of this coagulum, allowing the circulation through the vein to be re-established.

The *suppurative phlebitis* is always preceded or accompanied by the adhesive form of the disease, the adhesive action bounding and limiting the suppuration, and preventing the pus from becoming mingled with the current of the blood. If the plastic plug is sufficient to occlude the vessel, or if it become absorbed or metamorphosed with pus, then this fluid may get access to the general circulation, and produce that serious and fatal train of symptoms constituting pyemia, and depending on the admixture of pus with the blood. In this form of the disease, the pus is usually found between the coats of the vessel and the plug, or in a portion of the vessel unoccupied by coagulum, but confined at either end by a mass of plastic matter; when thus limited or encysted, it can do no mischief to the system; but if the plug that bounds it becomes absorbed or degenerates, it will mix with the general current of the blood. Pus has been described as forming in the centre of the coagulum, but Gulliver has shown that in many cases the fluid described as pus is merely disintegrated fibrine.

The *diffuse phlebitis* is an erysipeloid form of the disease, often running for a considerable distance along the coat of the vein, which becomes thickened, pulpy, and red, without adhesions forming, or the blood coagulating; indeed, in these cases there appears to be a great want of plasticity in this fluid. This form of phlebitis is commonly, though not always, fatal; its vitality was supposed by Hunter to be owing to the extension of the inflammation to the heart, and by Hodgson to the extent of surface affected; but Arnott has shown that the inflammation scarcely ever reaches the heart, and that the extent of vein inflamed is commonly very limited; it not unfrequently happening that the disease proves fatal when but a few inches are affected, as in the vessels of a stump. Hence it is probable that death is owing either to the admixture of pus with the blood that circulates through the inflamed portion of the vein, or by such changes induced in the blood by the inflamed surface over which it passes, as are incompatible with life.

The essential difference between these forms of phlebitis would therefore appear to depend on the formation and situation of the plastic matter. So long as the inflammation is purely adhesive, or, as the pus formed by it is bounded by adhesive plugs, it does not differ in its effects from ordinary inflammation; but if the pus get into the circulation by the breaking down or disintegration of these limiting plugs, or if the blood be deeply and seriously altered in its characters by changes induced in its passage over the inflamed surface, then we get those peculiar phenomena indicative of general blood-poisoning; which have been described as pyemia. (Chap. 28.)

The *symptoms* of phlebitis vary according to the form it assumes. In the adhesive phlebitis the action is usually localized and limited; very commonly arising from traumatic causes, and not unfrequently sub-acute. When traumatic, it may occur in any vein that is wounded, but when idiopathic, it commonly occurs in those situated in the calf or leg, especially if they are varicose. The inflamed vein is hard, swollen, knobbed, and painful, the knobs constituting distinct enlargements opposite to the valves; if superficial, it is of a reddish-purple color, and is attended with some degree of stiffness and inability to

move the limb. There may perhaps be no pain, but only deep tenderness over the course of the vessel. There is always some œdema around the inflamed vein, and in the part that supplies it with blood. This œdematous condition of the limb is a most important diagnostic sign in deep-seated phlebitis when the vein cannot be felt, as in the pelvis, for instance, and may perhaps be the first symptom observed, coming on either suddenly or gradually. The œdema may give rise to a hard, white, and tense condition of the limb, which pits on pressure, though in some cases the hardness is too great for this. Occasionally, in deep phlebitis, the limb may suddenly swell to a considerable size, without there being any sub-cutaneous œdema. In a case of phlebitis of the deep veins of the leg and thigh, lately under my care, the calf of the affected limb suddenly enlarged with great pain and much distension of the sub-cutaneous vessels with fluid blood, but without any sub-cutaneous œdema. As the inflammation subsides, the swelling of the limb goes down, the circulation passing through its former channels, or the blood being carried off by the collateral venous system. If suppuration take place, no change takes place in the symptoms so long as the pus is localized or encysted, until it perforates the coats of the vein, and passing into the external cellular tissue, forms a common abscess. If it break through its plastic barriers, then, however, a very different result occurs, and the symtoms of purulent infection come on. The constitutional disturbance in these forms of phlebitis is often of a very mild character; in other cases, however, symptoms of well-marked pyrexia manifest themselves, often accompanied by rather a depressed state of system.

The *treatment* of adhesive phlebitis consists in the free application of leeches along the course of the inflamed vessel, with rest of the limb, and fomentations; at the same time salines and purgatives must be administered, and the ordinary antiphlogistic means be had recourse to. If depression come on, carbonate of ammonia must be early given. The hardness which is often left after the removal of the inflammation, may usually be got rid of by salt and nitre poultices, as recommended by Dr. Basham. If abscesses form, they must be opened wherever they occur. If œdema of the limb continue, the application of blisters, or the pressure of an elastic roller, will remove this troublesome symptom.

The *diffused phlebitis* is ushered in by the ordinary symptoms of pyrexia, at the same time that pain and tenderness, with a certain amount of œdema and hardness, may manifest themselves along the course of the inflamed vessel. These symptoms, however, speedily give way to those that characterize the lowest forms of ataxic fever, such as a fluttering pulse, a brown tongue, sordes about the mouth and teeth, with much anxiety of countenance, diarrhea, vomiting, extreme prostration, delirium, and death. These symptoms are, indeed, due to the formation of pus in the vein, its admixture with the blood, and consequent poisoning of the system. The whole danger and peculiarity of diffuse phlebitis depend, I believe, upon this circumstance, and I would, therefore refer for the consequences and treatment of this form of the affection to the chapter on pyemia (p. 381).

VARIX.

By *varix* or *varicose veins* is meant a dilated condition of these vessels with hypertrophy of their coats, giving rise to œdema, tension, weight, and pain in the parts they supply, often with a good deal of numbness, difficulty in motion, or loss of power in the affected limb. In other cases, their pressure on the nerves of the part, as when occurring in the spermatic cord, may give rise to very severe suffering.

In appearance, varicose veins are tortuous, dilated, and sacculated; they are serpentine in their course, and feel thick under the finger. They may be superficial or deep-seated; when superficial, the disease is often limited to one of the larger venous trunks of a limb, the smaller branches not being engaged. This

we commonly see to be the case in the internal saphena; in other cases, the small cutaneous veins alone may be affected, appearing as a close network of a purplish-blue color under the skin, with much discoloration of parts, and some œdema of the limb; or both sets of vessels may be implicated. The deep-seated varix is not by any means so common as the superficial, and when it occurs, is generally the result of the pressure of the tumor, or of some similar cause Varicose veins, especially when superficial, are very apt to inflame, with coagulation of the blood within their sinuses.

The veins of the skin and mucous membranes are those that are most liable to this affection. It is most commonly met with in the legs, and more particularly in the trunk of the internal saphena; but any of the superficial veins, as of the arms, chest, head, neck, hypogastrium, or thorax, may be affected; the veins about the anus are especially liable to varix, constituting some forms of pile; so also, the spermatic veins very often become enlarged, constituting varicocele. As a general rule, superficial varix is infinitely more common in the lower than in the upper part of the body, owing evidently to the tendency to the gravitation of blood in the more dependent situations. When occurring at any point above the pelvis, it may be looked upon as arising, in all probability, from the pressure of a tumor of some kind upon the large venous trunks. The deep-seated veins that are principally affected are, the internal jugulars, the vena azygos, and the veins of the prostate.

The *causes* of varix are generally such conditions as induce more or less permanent distension of the veins. Thus, for instance, blows, strains, and habitual over-exertion of a part, by driving the blood into the sub-cutaneous veins, may give rise to their distension; so also, certain occupations may favor gravitation of blood to the lower part of the body; then, again, the length of a vein, as of the internal saphena, may occasion its dilation by the weight of the long column of the contained blood. Any obstacle to the return of the blood from a vein, as the pressure of a tight garter below the knee, or of a tumor upon one of the large venous trunks, may give rise to its permanent distension, as well as to that of all its branches. In other cases, again, the affection, or the disposition to it, appears to be hereditary, and in many instances, it is difficult to recognise any cause except an enfeebled and relaxed state of the walls of the vessel, such as is met with in tall, debilitated, and phlegmatic people. Age influences materially the occurrence of the disease, which is rare in the earlier periods of life, but gradually increases as the individual advances in years. In women, especially, the affection is common, in consequence, partly, of natural debility, but more frequently from the pressure of the enlarged uterus during pregnancy.

In *structure* varicose veins are sometimes simply dilated without any thickening of their coats, but in other instances they are truly hypertrophied, their cavity being dilated and walls thickened, the vessel likewise being elongated, forming curves, and bending back on itself. Sometimes the enlargements at particular points appear to be multilocular, the vein forming a series of curves and dilatations together. The valves are always insufficient in varicose veins, being usually bent backwards or ruptured, and the lining membrane is marked by longitudinal striæ. The blood in these vessels has a tendency to coagulate in large masses, the vein being at times the seat of inflammation, by which this tendency is materially assisted. The neighboring and subjacent parts are much modified in structure, and there is usually chronic œdema, with infiltration of the skin and cellular tissue, which may at last run into ulceration, giving rise to the varicose ulcer, which has already been described (p. 351), and which, if communicating with a large branch, may yield a copious or even fatal hemorrhage.

The *treatment* of varicose veins is of a palliative and curative kind. The palliative treatment consists in moderate compression exercised upon the vessel, so as to support its weakened and dilated coats, and thus prevent its further

distension and the pain occasioned by this, as well as the other after-consequences, such as œdema, disorganization, and ulceration of the skin. The pressure must be applied very smoothly and evenly, lest it irritate and ulcerate the skin, or produce distension of the vein below the part compressed. For the purposes of compression, bandages and elastic stockings are commonly employed. I know of no better material for this purpose than Churton's elastic bandages, and I have in many cases used Huxley's stockings, made of an elastic woven material, with great advantage. In some cases an elastic pressure by means of a vulcanized India rubber band or garter may be applied around the limb so as to simulate the action of the valves of the vein; by compressing this it cuts off the weight of the column of blood from the terminal branches. In other cases again the application of a truss to the upper part of the saphena vein, as recommended by Colles, may be of service.

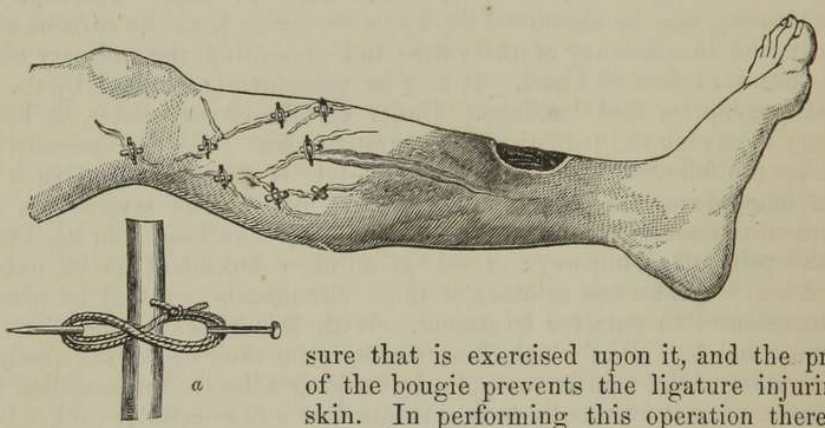
If a varix bursts, violent bleeding may suddenly take place so as to induce faintness and even death. The treatment consists in laying the patient flat on the floor and raising his leg, when the hemorrhage will cease. The copiousness of the bleeding may be accounted for by its occurring from the *cardiac* side of the varix, the insufficiency of the valves not presenting the ordinary obstacle to the downward flow of blood. It may be permanently arrested by the pressure of a compress and bandage. Under certain circumstances, it becomes necessary to change the palliative for a curative plan. This is especially requisite under the following three conditions: — 1st. If the varix be of such large size as to produce much inconvenience, or to give rise to severe pain by its pressure on the nerves in its neighborhood; 2d. If a varicose vein has burst, or is on the point of giving way: or, 3d. If an ulcer dependent on its existence will not heal. Under one or other of these circumstances it may be necessary to have recourse to curative treatment. With this view various plans have been recommended, all of which, however, have for their object the production of obliteration of the vein at one point by exciting adhesive inflammation there, and thus causing it eventually to degenerate into a fibro-cellular cord. In this way the trunk of a varicose vein and the larger masses of varix may be occluded. But can the disease be cured by the local obliteration of the vein? To this question I have no hesitation in answering in the negative. Though the trunk be obliterated, a collateral venous circulation is set up, which is very apt in the course of a few months to take on a varicose condition, and thus to cause a return of the disease some time after the operation. But though the cure is not radical, much benefit may often be effected, by removing varicose knots that occasion pain or inconvenience, by enabling an ulcer to cicatrize, or by occluding a vein from which hemorrhage has occurred. The principle of all curative treatment in varix consists in exciting adhesive and localized inflammation in the vein so as to occlude it, and thus, by directing the blood into other channels, to relieve the distension of the diseased vessels and the inconvenient results that follow this. As the treatment thus necessarily involves the artificial excitation of phlebitis, there is always some little risk of the inflammation passing beyond the adhesive stage into that of suppuration, or diffuse inflammation: but out of upwards of 150 cases, in which I have performed these operations, not one has died.

Various plans for obliterating the veins have been recommended by surgeons. They resolve themselves into four principal heads of treatment. 1st. The subcutaneous section of the vein, or the excision of an inch or so of the vessel. This plan of treatment is severe, and not unattended by danger, as we learn from Sir B. Brodie. 2d. It has been recommended by Mayo, Seutin, Bonnet, and others, to excite inflammation in the vein by producing a series of deep eschars or issues in the skin covering it, by the application of a caustic, such as the chloride of zinc or potassa fusa. Mr. Skey speaks very favorably of this mode of obliterating varicose veins, as being devoid of danger. He recom-

mends the eschars to be made by the application of a powder, composed of three parts of lime and two of potass, made into a paste with spirits of wine at the time of application. The eschars should not be larger than a split pea, and their number must depend on the extent of the disease. 3d. Others again recommend the obliteration of the vessel by introducing needles into it, and transmitting a galvanic current along and across them. Of this plan of treatment I have not had any experience, nor do I believe that it is ever employed by surgeons in this country.

4th. The most convenient and safest way of obliterating the vein, in my opinion, and that which I always employ, consists in compressing the vessel at several points, by passing a hare-lip pin underneath it, laying a piece of wax-bougie over it, and then applying the twisted suture around the pin and over the bougie (fig. 162 *a*). In this way the vessel gradually ulcerates by the pressure that is exercised upon it, and the presence of the bougie prevents the ligature injuring the skin. In performing this operation there are a few points that require attention; thus care must be taken that the vein be not transfixed, but that the pin be pushed, or rather dipped, underneath it; the ligature should not be too thin, and must be applied tightly over the bougie; several pins, as many as eight or ten, if necessary, should be introduced along the course of the same vessel, at distances of about three-quarters of an inch from one another; those highest up should be put in first, and they should be left in for at least a week or ten days, by which time the obliteration of the vessel will have taken place. I believe that all the danger of the operation consists in the transfixion of the vein by the pin; the operator may always know when he has done this by the escape of a few drops of venous blood; when the pin is properly passed under the vein, the operation is a perfectly bloodless one. If the vein is transfixed, the pin should immediately be withdrawn and passed at another point; if it be allowed to remain in the vein, it will act as a foreign body, and suppurative phlebitis will ensue. When the vein is properly compressed between the pin below and the bougie above, adhesive inflammation takes place in it, and it becomes obliterated at the point of pressure. By attention to these circumstances I have never met with any ill consequences in any of the cases in which I have performed this operation.

Fig. 162.



In addition to the application of the pins in the usual way, Mr. Lee has recommended the subcutaneous division of that portion of the vein which is included between them, after coagulation of the blood has taken place. This, I have found to be a useful addition to the ordinary treatment, and to insure the obliteration of the vessel.

The points of the pins may be prevented pressing injuriously upon the skin, by putting small pieces of adhesive plaster under them. The powers of the

constitution should at the same time be improved, and the activity of the circulation kept up by nourishing diet, tonics, and wine. Whilst the pins are in, the patient must not be allowed to move about, and after they have been taken out, the limb should be bandaged for some time. In general no ulceration takes place about the pinhole apertures, but occasionally in debilitated constitutions, a sore forms, which requires to be treated on ordinary principles.

CHAPTER XXXV.

DISEASES OF ARTERIES.

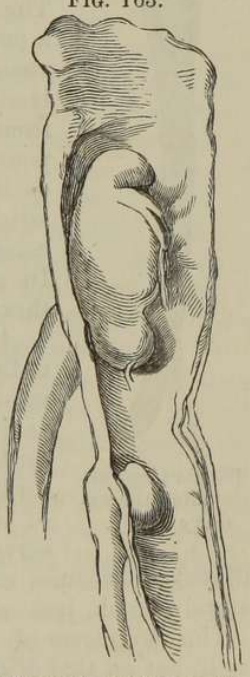
ARTERITIS.

THE causes of inflammation of arteries or of *arteritis* are extremely obscure; in many cases it arises from constitutional causes, with the nature of which we are as yet unacquainted; in the majority of instances, however, it is distinctly of traumatic origin, occasioned by the wound, rupture, or ligature of an artery.

Arteritis occurs under two distinct forms, as the *adhesive* or *limited*, or as the *diffused* or *erysipeloid*. Adhesive arteritis may either be of an acute or chronic character, and may be idiopathic or traumatic in its origin. Diffuse arteritis invariably arises from injury or ligature of the vessel.

In the *adhesive arteritis*, both the coats of the vessel and the contained blood undergo important alterations. In the simplest form, arising for instance from the pressure of a tumor upon an artery, the coats are thickened and fused together, as it were, so as to form an impervious cord; in the more acute forms of the disease, the sheath and the external coat become pulpy and vascular, with effusion of plastic matter in and around them. The middle coat does not undergo any primary change, but after a time becomes contracted, thickened, and somewhat softened. The internal coat becomes softened, pulpy, and stained by imbibition of the coloring matter of the blood. In consequence of these changes in the coats, the vessel loses its elasticity and becomes brittle. After the inflammation has existed for a short time, a plug is deposited in the diseased part of the artery; this plug assumes two distinct forms. It may be deposited as a membranous layer of decolorized fibrine, occluding the orifices of collateral branches (fig. 163); but most frequently it is deposited in the form of a conical plug, which completely blocks up the vessel at the part inflamed, below which the calibre of the artery is somewhat contracted (fig. 164). These plugs are formed of two distinct materials, the middle and lower part being a mass of a yellowish or reddish color, composed of inflammatory exudation-matter, intermingled with fibrine deposited upon it by the circulating blood, and adhering firmly to the contiguous walls of the vessel. The upper portion of the plug is of a black color, and consists of simple coagulum, deposited upon and tailing on to the decolorized mass; it is

FIG. 163.



Plastic deposits in aorta.

usally long, narrow, and stringy, and is not adherent to the sides of the vessel. These plugs may continue permanently to block up the artery, which gradually contracts upon them so as to be eventually converted into a fibro-cellular cord, or they may be partly absorbed or channelled through their centre, or lastly, they may be entirely removed by absorption, and the calibre of the vessel freely restored.

Fig. 164.

Plastic plugs occluding the axillary artery.

In *diffuse arteritis*, the morbid appearances extend more widely, spreading along the coats of the artery to a considerable extent; there is redness of a deep claret color, injection, and thickening of the coats, a loss of the physiological properties of the vessel, with an absence of all plastic exudation.

The secondary effects of arteritis are of considerable importance. The plug, which renders the vessel impervious by obliterating it, may in some cases give rise to gangrene of the parts supplied. This is especially apt to occur if the arteritis be acute, if the patient be aged, or if the plug be so situated as to occlude some of the principal anastomosing branches, so that there may not be time or opportunity for the collateral circulation to establish itself. In other cases, again, plastic matter may not only be deposited at the part inflamed, but may even be carried lower down than the original seat of disease, and thus accumulate in the terminal branches of the artery. The vessel will thus be obstructed at two points, between which a pervious part will be included. This double occlusion of the vessel, I believe, renders gangrene of the limb inevitable, at least in all those cases in which I have seen mortification result from arteritis, this condition has existed. The plastic matter poured out at the inflamed point, may in some cases be carried on through the terminal branches of the vessel into the capillaries, and thus entering the general circulation form buff-colored deposits in various organs, more especially in the spleen. In other cases, again, it is carried into the veins, giving rise there to phlebitis and to other similar conditions.

Arctation or even *occlusion* of the interior of the artery, not unfrequently occurs as a consequence of inflammation of the vessel. This usually results from chronic arteritis, often excited by the pressure of a tumor or of some other local irritant. As it is usually a slow process, there is abundant time for the anastomozing circulation to be set up, so that the vitality of the limb, or part supplied by the diseased vessel, is preserved. The artery, that has been so narrowed and closed, ultimately becomes converted into a cellulo-fibrous cord, up to the nearest collateral branch, just as if it had been occluded by the application of a ligature.

The *symptoms* of arteritis depend not only on the condition of the vessel itself, but on that of the parts which it supplies. There is pain, with some tension and stiffness of the affected limb, with a good deal of tenderness, and a cord-like feeling along the inflamed vessel, in which also a jerking and forcible pulsation can be felt. The pain below the part of the artery that is inflamed, is always of a very severe character, and is distinctly of two kinds; superficial, and deep; the superficial is seated in the skin, which is excessively sensitive to the touch, so that the patient cannot bear the finger to be laid upon it, just as is the case in neuralgia; it is of a smarting and pricking character, and is I believe always associated with more or less loss of muscular power; the deep pain is of a burning and lancinating character, and not only follows the course of the vessels, but strikes through the limb in different directions. If the inflamed part of the vessel be not completely occluded by the plastic plug depo-

sited in it, the pulsation in the arteries of the limb, below the seat of the disease, may continue much as usual; but in the majority of cases the pulsation ceases in all the vessels on the distal side of the inflamed spot, the limb gradually loses its temperature, becoming of a dark or livid color, and cold; but yet the inordinate sensibility of the surface continues. As the gangrene advances, however, this is lost; the parts, at the time that they lose their sensibility, assuming the ordinary characters of dry, shrivelled, or mummified gangrene, until all indications of vitality cease. If, however, the veins be inflamed, as well as the arteries, the dark moist variety of mortification will result. It is in this way that some of the so-called "spontaneous gangrenes" are occasioned. The constitutional symptoms, which in the local limited adhesive arteritis are in the first instance of an inflammatory kind, speedily sink into the ataxic form as gangrene comes on. In the diffuse arteritis, the asthenic fever sets in early, and speedily destroys life.

The spontaneous gangrene resulting from arteritis may occur in the upper as well as in the lower extremities, and is not unfrequently met with in young people; at least in most of the cases in which I have seen it, it has occurred in individuals under the age of thirty. When the result of pure arteritis, independent of any other structural affection of the coats of the vessel, the gangrene I believe most commonly occurs in the upper extremity. Arteritis, however, is by no means necessarily followed by mortification; the liability to the loss of vitality depends on the seat of inflammation, being greater when it takes place in the neighborhood of the large collateral trunks of the limb, and when it is of an acute character, so that the anastomosing circulation has not time to establish itself. It also occurs more frequently when the arteritis is idiopathic, than when it is traumatic, as then a larger extent of vessel is plugged, and there is a greater tendency to the occlusion of those important collateral branches by which the vitality of the limb is ultimately to be preserved. The clogging of the terminal branches by the plastic matter poured out at the seat of inflammation and washed down into the lower part of the limb, is a powerful cause of gangrene. Those arteries, the inflammation of which most commonly terminates in this way, are the iliac and the axillary; and it is not uninteresting to observe that the cause of danger in this disease is the very condition that gives safety in phlebitis, viz., the plugging of the vessels with plastic matter.

The *treatment* of arteritis must be conducted on general principles. Leeches should be applied to the part and perhaps blood taken from the arm; calomel and opium may then be administered, but as a general rule I would prefer the exhibition of those salines, such as nitre and the acetate of potass in large doses, which we know by experience to possess considerable influence in the solution of fibrinous deposits. When gangrene has supervened, we must wait for the line of separation before amputation is had recourse to, as the disease must be looked upon as being of constitutional origin.

STRUCTURAL DISEASES OF ARTERIES.

The arteries are the seat of various structural lesions which play an important part not only in giving rise to ulterior diseases in the vessel itself, but in disposing to various affections of the organs which it supplies. If we look on an artery as a tube composed of tissues that differ largely in their organization and structure, we must necessarily consider their diseases to be equally varied, and we shall find that whilst the changes which take place in the external or cellular coat, in which the whole of the vital or nutritive activity of the vessel resides, are chiefly of a conservative character, those that have their seat in the internal and middle coats have a destructive tendency. This important difference in the character of the diseases of the coats of the vessel, is dependent on their relative degrees of vascularity and of vitality. The diseases of the internal coat

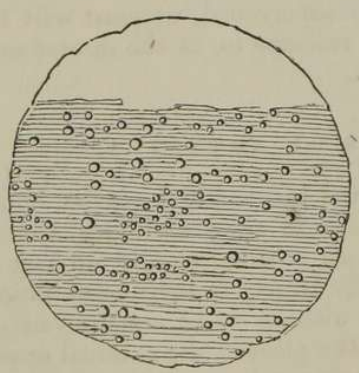
are the most interesting in a pathological point of view, those of the external coat in a practical one.

The coats of an artery are liable to the following changes:—1st. Plastic deposit on and under the lining membrane; 2d. Fatty and granular degeneration; and 3d. Calcification.

1st. *The plastic deposits* on the free surface are of a fibrino-albuminous character, occurring in the form of rounded, semi-transparent, and glistening masses. usually met with in the aorta or larger arteries around the mouths of their secondary vessels, or of aneurismal sacs; and not unfrequently agglomerated on calcareous spiculæ, where they attain great thickness. They are almost structureless, gelatinous, sometimes rosy-looking, and cut with a hard cartilaginous section. The plastic deposits on the attached surface of the lining membrane are opaque, semi-transparent, yellowish-white, elastic, but hard masses, composed essentially of plastic matter with some oily globules intermixed.

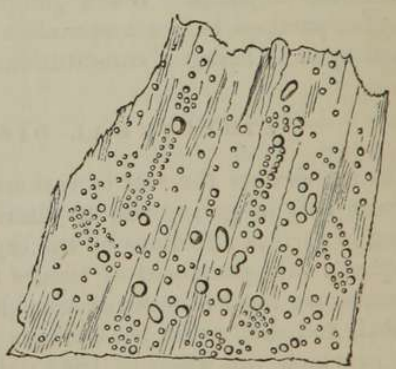
2d. *The fatty and granular degenerations* of the internal coats are of the most interesting character, and play an important part in arterial diseases. They occur under the different forms of *atheroma* and *steatoma*, and are met with either in the arterial coats themselves, or in the plastic deposits which occur upon or underneath them. These atheromatous deposits occur in very different forms, according to their age, &c. Their first appearance is in the shape of fine white opaque streaks, situated in the substance of the lining membrane of the artery. As such, they are most commonly met with in the upper part of the arch of the aorta and in the neighborhood of the orifices of the large arterial trunks; especially along that part of the vessel from which the intercostals arise. Here they may be seen at a very early age. I have met with them in children of three, five, or seven years old. As the disease advances these streaks aggregate together so as to form a large, white, and opaque patch; in this condition the middle coat is implicated. This becomes thinned by the pressure of the patch, and, from being yellow and elastic, is altered into a grey, semi-transparent, and inelastic membrane, which often becomes stained by imbibition with blood, and corresponds to the steatomatous deposits of Scarpa and Hodgson. In the third stage the patch softens, becoming converted into a pultaceous, or cheesy mass, and even sometimes undergoing complete liquefaction into a yellow creamy fluid, which has often been mistaken for true pus. These changes will always be found to be dependent on the abundant formation of fat globules and scales of cholesterine in it. These softened atheromatous patches will be found to be situated in a kind of pouch or depression in the internal or middle coats of the

Fig. 165.



Fatty deposits in internal coats.

Fig. 166.



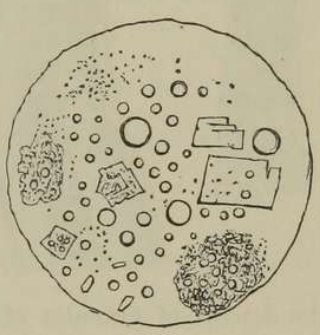
Early stage of atheroma.

artery, usually of a more or less oval shape. At the same time that the changes just described are going on in the coats of the vessel, an important alteration is

taking place in the connections between the internal and middle coats at the edge of the atheromatous patch; here they become firmly incorporated together, so that the one cannot be peeled away from the other, and the diffusion of the softened atheroma between the two membranes is arrested. So also, when the atheroma is washed away by the current of the circulation, the infiltration of the blood between the coats and out of the pouch thus formed in the walls of the artery is prevented.

The changes just described as taking place in the internal and middle coats of the vessel are of a destructive character, and tend to lead to its rupture; but coincident with these, conservative processes take place in the external coat. This becomes thickened, indurated, and strengthened by the deposit of plastic matter, until at last it becomes the sole support of the vessel, round the exterior of which it forms a thick and somewhat rugged wall. It is especially opposite the deeper and more eroded atheromatous patches that this consolidation of the external coat takes place, thus preventing the perforation of the artery in this situation.

Fig. 167.



Atheroma from old patch.

The nature and seat of these changes will be understood by what has been already stated concerning them. Atheroma essentially consists, as was first pointed out by Mr. Gulliver, in a fatty and granular disintegration of the arterial coats; the transformation into fatty and granular matter taking place both in old plastic deposits, and in the internal and middle coats of the vessel. The fatty matter consists of oil globules and cholesterine in various proportions, (figs. 165, 166) the plates of cholesterine being largest and most abundant in those cases in which the atheroma is the softest (fig. 167). This fatty transformation is one to which the fibrous tissues generally are peculiarly subject, and to which those that enter into the formation of an artery are especially liable. All those theories are consequently erroneous which attribute atheroma to previous inflammation, to suppuration, or to a deposit *sui generis* in the artery. The primary seat of these changes is the lining membrane of the vessel in the outer layer of which, corresponding to Henle's *fenestrated coat*, they are first met with, as I have often observed after macerating and dissecting diseased arteries.

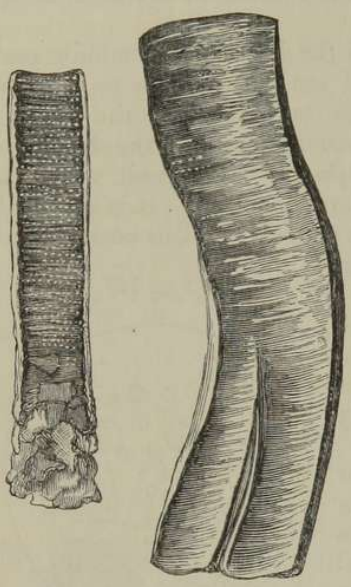
The most important consequence of these changes in the structure of the artery is the effect produced upon the vital properties of the vessel; instead of being an elastic resilient tube, reacting on the contained blood and serving to regulate its distribution, it becomes inelastic, and consequently, either gradually dilates in its calibre under the influence of the outward pressure of the blood contained within it; or, becoming incapable of aiding in the distribution of the vital fluid, tends to impair the due regulation of the supply to the organs to which it leads, and thus may indirectly occasion a diminution or even loss of their vitality, giving rise to softening, disintegration, or mortification of their tissue.

3d. *Calcification* of the arteries comes next in order of frequency to their fatty disintegration. This consists in the deposit in their coats of a quantity of hard and gritty earthy and saline matters, which, though commonly called osseous, presents none of the true characters of bone, no trace of bone-corpuscle or of vascular canal being ever traceable in them. Microscopical examination shows them to consist of an irregular crystalline, granular mass, without any evidence of organization, composed, according to Lassaigne, of 50 parts of animal matter, 47½ of the phosphate, and 2 of the carbonate of lime in every 100 The deposit always takes place in the first instance in minute sabulous

grains or granules; these after a time coalesce, assuming different forms according to the seat of the deposit and the age of the individual.

The *laminar* form of the deposit is the most frequent, and is principally met with in the larger arteries, such as the aorta, the iliac, and the carotids. In this variety calcareous masses and plates of various sizes, from a grain of sand to a shell-like plate an inch in width, is met with in these vessels. The thickness of the patch varies from that of silver paper to two or three lines across. Their shape is elliptic or triangular, the largest diameter being in the direction of the axis of the vessel. The edge of the plate is ragged, rough, and uneven, and the surface smooth and incurvated towards the cavity of the artery; if large, it is usually fissured or cracked, and surrounded by much atheroma. These patches are situated in the longitudinal fibrous coat, and are chiefly deposited where this structure abounds, as at the arch of the aorta, the bifurcation of the iliacs, and in the carotid arteries. The inner coat is usually thickened and opaque where it covers the patch, and the middle much thinned and wasted.

Fig. 168. Fig. 169.



The *annular* calcification principally occurs in arteries of the third magnitude, such as the popliteal and the femoral. It commences by the deposit of granules of calcareous matter (fig. 168), which are arranged in lines running transversely to the axis of the vessel; these lines gradually increase in breadth until they coalesce laterally, the intervening spaces being filled up, and the vessel being converted into a rigid tube (fig. 169). This form of calcification occurs in the transverse fibres of the middle coat, and is accompanied by but little atheromatous matter.

The *tubular* calcification appears to be an increased degree of the varieties just described, the arteries being converted into pipes or tubes of calcareous matter, with the exception of a few shreds and patches, and some atheroma deposited in its coats (fig. 146). It is especially the tibials and coronary arteries that are liable to this kind of transformation. When an artery has thus been converted into a tube of calcareous matter, masses of pale, opaque, waxy-looking fibrine are deposited in it, and may block it up more or less completely. These masses not uncommonly undergo subsequent atheromatous degeneration.

The various forms of fatty and calcarous transformation of the arterial coats that have just been described, are constantly found associated together in the vascular system of the same individual, and often indeed in the same vessel. It has been pointed out by Bizot that the symmetry of the arrangement of these morbid appearances in the corresponding vessels on opposite sides of the body is remarkably great, the arteries of one limb being often the exact counterpart in this respect to those of the other.

Causes. — The frequent co-existence of these various morbid changes in the same portion of the arterial system, point to their originating from one common cause, under the influence of which the coats of the vessel may become converted either into fatty or calcareous matter. Indeed, it is quite evident that these are "retrograde metamorphoses," to which all fibrous tissues are especially liable, under the influence of want of proper nutritive activity in the part. And, indeed, any circumstance that induces a depravation of healthy assimilation in the system generally, will specially tend to occasion a transformation of the texture of the more lowly organized tissues into products still lower in the scale of

organization. Under such influences as these, the fibrous tissues of which the arterial walls are composed, rapidly undergo disintegration and conversion into fatty, granular, and earthy matters.

That influence under which the vital forces of the system are most commonly diminished in activity, is, old age; and this diminution may be looked upon as natural at any period after the organization has reached its full maturity, whether this be early or late. So frequent, and indeed constant, are these transformations of the arterial coats during the decline of life, that they may be considered as the natural result of the diminution of the nutrient activity consequent upon advance in years. Gmelin has found that there is a progressive increase in the earthy matters contained in the coats of healthy arteries as the individual advances in life. Thus he has ascertained that the ash of the arteries of a newly-born child yields 1·86 phosphate of lime; the healthy arteries of an adult 1·25; and those of an old man 2·77 of the same salt; whilst the ossified arteries of an aged man contain 4·01. There is no precise period of life at which these changes set in; age is a relative term, and so soon as the system has passed its full maturity, in whatever year of life this may happen, there is a tendency for these deposits to take place in considerable quantity. These senile transformations, therefore, can scarcely be looked upon as pathological changes in many instances. But the same process of degradation of tissue may commence at any, even the earliest periods of life, under the influence of causes that impair the vital forces; and it is in this way that phthisis, granular kidneys, chronic gout, constitutional syphilis, &c., have a direct tendency to occasion these changes in the arterial coats. It is a favorite supposition with many pathologists, that these changes result directly from inflammatory action; this certainly does not appear to be the case, but it is by no means improbable that an artery in which the inflammatory process has taken place, may thereby have its nutrition so modified as to become more susceptible to early and extensive degeneration, and that the plastic matters thrown out as the result of the inflammation will be especially liable to undergo those changes that ultimately result in their conversion into fat and calcareous matter.

Some arteries are more liable to these structural lesions than others; thus, the ascending aorta is most subject to fatty degeneration, whilst the calcareous transformation is most frequently met with in the arch and abdominal portion of the vessel. The arteries of the lower extremities, viz., the femoral, the popliteal, and the tibial, are chiefly affected with calcareous deposits, whilst the fatty are commonly met with in the vessels of the brain; and some arteries appear to be exempt from disease; thus, Tiedemann states that he has never found the œsophageal arteries ossified. The difference in the liability of different arteries to disease is, no doubt, in a great measure to be accounted for by the different degrees of development of the longitudinal fibrous coat in different parts of the arterial system; this being, I believe, in most instances the primary seat of the affection. Thus, in the aorta, the coronary arteries, and those of the brain, in which it abounds, we find these transformations frequent. The distance of the tibials from the centre of circulation, and the consequent diminished nutritive activity of their coats in old people, may account for the frequency of their degenerations. Those points of the arteries likewise upon which the shock of the onward wave of blood is most directly received, are more subject to degeneration than neighboring parts of the continuity of the wall of the vessel. This is especially observable at the origins of the arteries that spring from the arch of the aorta, and at the bifurcation of the iliacs. It is also not improbable that the increased pressure of the blood upon the coats of arteries that lead to diseased organs through which the circulation is obstructed, may tend to their degeneration. Sex exercises but little general influence on the liability to disease in the arterial system; though it specially tends to the occurrence of those changes in certain arteries. Thus Bizot states that the arteries of the upper extremity are most frequently diseased in women, and those of the lower in men.

The structural lesions that have just been described produce certain local effects, often of considerable importance, on the parts which the affected vessels supply with blood. For the proper and healthy nutrition of a limb or part to be carried on, two great conditions are required so far as its arteries are concerned. 1st, that the integrity of the structure of the walls of the vessels continues perfect; and, 2d, that their channels remain pervious; for although the arterial system possesses remarkable conservative power in its arrangement and distribution that tend to counteract these effects, yet, by slow degrees, a deterioration of function and disintegration of structure take place in the part immediately supplied by the diseased vessel. Thus, in the limbs, we have all the signs of a defective circulation, coldness of the feet, cramps, and spasms of the muscles; whilst in organs, softening of tissue, fatty degeneration, and other evidences of the want of a proper supply of blood leading to impaired nutrition manifest themselves. Besides these various changes that take place in the parts to which the diseased arteries are distributed, ulterior effects are produced upon the vessels themselves, which may lead to important consequences. These consist in ulceration of the coats of the artery; — their spontaneous rupture; the contraction or occlusion of the interior of the vessel; and, lastly, its dilatation into some of the various forms of aneurism.

The *ulceration* of arteries, though frequently spoken of, in reality seldom occurs; the so-called ulceration being in general an erosion occasioned by a patch of softened atheroma and its investing membrane having been carried away by, and into the current of blood, which then washes the base of the depression thus produced in the middle coat, but is prevented extending between the coats by the process of fusion and cohesion which takes place in them around the patch. This apparent ulcer is deepened by the deposit around its margin of plastic matter, often in large gelatinous-looking masses. When true ulceration of an artery takes place, it is by destructive action from without, and not by any of these disintegrating processes commencing within the vessel.

The *spontaneous rupture* of an artery is of rare occurrence, and never happens without disease of its coats. Experiments made by Dr. Peacock, which I have repeated, and the accuracy of which I can fully confirm, prove that a healthy artery will sustain a very great pressure of water injected into it, without its walls giving way. But if these have been softened or weakened by disease, they may be unable to resist even the ordinary impulse of the blood, and if this be driven on by any unusual forcible action of the heart, as under the influence of sudden violent strains or exertions, they may give way. This occurrence would be much more frequent than it is in atheromatous and calcareous patches, were it not for the conservative consolidation of the external coat of the vessel supplying that resistance which had been lost by the destruction of the internal and middle tissues. Hence this rupture is most frequent in those vessels, the outer coat of which is thinnest; and in which consequently it can least supply the place of the others, as in the arteries of the brain and the intra-pericardial aorta.

The *contraction* and *occlusion* of arteries are by no means rare sequences of the structural lesions of these vessels. We have already seen that these conditions may arise from inflammation of the coats in any way excited, as by the pressure of tumors; but, besides this, the structural changes that take place may produce narrowing and closure of the vessel in various ways. Thus the diseased patch may project into the artery in such a manner that plastic matter and coagulum are gradually deposited upon it until the interior of the vessel is blocked up; or the irritation of the morbid products may give rise to chronic inflammation in the coats, occasioning contraction, the effusion of lymph, and their consequent occlusion. In one or other of these ways, arteries of all magnitudes may be gradually narrowed and at last completely closed, and yet

the patient survive; and the parts supplied by the obstructed vessel maintain their vitality in consequence of the collateral circulation being sufficiently active to keep up the supply of blood to them. The vessels that are most frequently blocked up in this way are the tibials; next to these perhaps the carotids; the other arteries are but rarely so occluded. Yet many instances have been collected by Tiedemann of this morbid process affecting most vessels; but more especially the iliacs, the brachial, and axillary arteries, and the different branches of the abdominal aorta. Tiedemann records from various sources no less than eight cases in which the abdominal aorta was completely closed, in all of which so full and efficient a collateral circulation had been set up, that the vitality of the lower part of the body was perfectly maintained, and in most the morbid state not suspected during life. Besides these cases, he states that there are twelve instances on record of great narrowing of the aorta at that point where the ductus arteriosus is implanted into it in fœtal life. These would appear in some way connected with the closure of the duct, as in every case the indentation was greatest on the convex part of the aorta, which had been drawn in towards the mouth of the duct, as if the vital contractile force necessary for the closure of this had extended itself to the aorta, and produced a similar action in it.

When any of the arterial narrowings, or occlusions, occur in a gradual manner in early life, or in a part where the collateral circulation is free, no ill effects result; but in an opposite condition the interference with the circulation leads to the local death of the part supplied by the diseased vessel. This is particularly the case in the lower limbs of old people, where the circulation is extremely feeble, both as the effect of age and in consequence of distance from the heart, and it is in this way that the true senile gangrene or mummification of the limb occurs. The pathology of this affection has already been adverted to, but it may not be out of place to state here, that whilst some have considered the gangrene as entirely the result of arteritis, others look upon it as consequent on the occlusion of the vessel from disease of its coats, and each party has laid down principles of treatment in accordance with their view of the pathology of the affection. From what has preceded, it would appear that the arteries of a limb may be occluded, and that consequently gangrene may result from either condition. The occlusion from acute arteritis followed by gangrene, most frequently occurs in the upper extremities and in young or middle-aged people, is preceded by local and constitutional symptoms of inflammation, and, in it, the artery presents on examination the true inflammatory plug. The occlusion from calcification and atheroma chiefly occurs in the lower extremities, and in old people, is preceded by a rigid condition of the vessels, by cold feet, cramps, numbness, and weakness of the legs, and after removal, the arteries will be found to be converted into rigid unyielding calcareous tubes, with some deposit of atheroma, and with waxy-looking masses of fibrine filling up their interior. Besides these two distinct forms of the disease, there is a third and very common variety, in which a low form of inflammation takes place in previously diseased arteries, and in which we find a combination of the two conditions.

With regard to the treatment of narrowing, or occlusion of the arteries unconnected with gangrene, I have little or nothing to say, except that if there be reason to suspect such occurrence in a limb, care must be taken to keep the part warm by means of appropriate clothing, and if there be much pain, to allay this with opiates. If gangrene have come on, it must be treated with reference to its cause; when connected with arteritis, it has already been discussed, but when it occurs from structural disease of the coats of the vessel, then the treatment must be directed by the existence, or not, of any complicating inflammation, in accordance with those principles that have been laid down in discussing the general management of gangrene.

CHAPTER XXXVI.

ANEURISM.

When the arterial walls have undergone more or less fatty degeneration, whether that consist in the distinct deposit of patches of atheroma, or in a sort of molecular deposit of fat globules in the tissues comprising their coats, their natural elasticity and resiliancy become lost, proportionately to the amount of fatty change that has taken place within them. Hence, as the artery becomes less and less able to contract on its contents, and to recover during the diastole the tension exercised on its walls during the systolic impulse, it gradually becomes distended by the repetition of the shocks which it sustains, and thus either complete or partial dilatation of its cavity takes place. I believe that this loss of elasticity and of power of contracting on its contents, which eventually results in the dilatation of the vessel, never occurs except as the result of previous disease of the coats. In the very numerous specimens of dilated arteries that I have examined, I have never found one that had not undergone fatty degeneration, or atheromatous deposition. Calcification, on the other hand, rather prevents dilatation of the artery, by hardening the coats and converting them into rigid inelastic tubes; but atheroma softens them, and causes yielding of that portion of the vessel affected by it. I have frequently observed that the whole of the artery may be healthy except at one part, where there was an atheromatous patch, and that there the vessel was dilated; or that the whole of its coats might be calcified except at one spot, where atheroma was deposited, and where consequently the coats had yielded under the outward pressure of the contained blood. This general or localized dilatation of the arteries is termed *aneurism*, an affection that is, I believe, invariably dependent upon the coats having been softened, atrophied, and disintegrated by fatty degeneration, and consequently yielding to the eccentric pressure of the contained blood.

Aneurism may be classified as follows:

1. Fusiform. — True.
2. Sacculated. — { α True. / β False..... { α Circumscribed. / β Diffused.
3. Dissecting. —

1st. The *fusiform* or *tubular* aneurism is a preternatural dilatation of an artery, all the coats of which are equally expanded through the whole circumference of the vessel. It most frequently occurs in the aorta, but may, though rarely, be met with elsewhere. These fusiform aneurisms are not mere dilatations of the vessel, but there is elongation, thickening, and degeneration of its walls as well. The elongation of the artery in these fusiform aneurisms is as marked as its dilatation, and is always very considerable. Thus, the arch of the aorta may attain a length of several inches, with a considerable space between the origins of the carotids, the innominata and the subclavian, at the same time that its walls are greatly thickened, nodulated, and rugged. Sometimes several of these tubular or fusiform aneurisms are met with in the same vessel, with healthy portions of the artery between them. From these dilatations sacculated aneurisms not uncommonly spring. On examining the structure of a fusiform aneurism, it will be found that it is always composed of a uniform expansion of all the coats of the artery, which are at the same time somewhat altered in character; thus, the outer coat is thickened, the middle rigid and inelastic, and the inner one stiffened, rugged, and tuberculated, by the deposition beneath it of various plastic and atheromatous masses. No coagula, however, are found in

these dilatations, but a few filamentary shreds of fibrine are occasionally seen to be attached to their inner wall. The arteries that are usually the seats of these peculiar changes are the arch of the aorta, the iliacs, and the femorals; this particular form of aneurism never occurring in any vessels in which the yellow elastic coat is not largely developed, and hence not being met with in arteries below the femorals in point of size.

These fusiform dilatations, especially when seated in the arch of the aorta, may attain a very considerable magnitude, and may consequently exercise very injurious pressure on contiguous parts; thus producing great distress and danger of life to the patient. They are usually extremely chronic, increasing but very slowly, and being compatible with existence for many years, but at last they usually destroy the patient, and they may occasion death in several ways; thus, if situated in the aorta, the great mass of blood in the sac may, by impeding the circulation, overpower the heart's action, so that it may be unable to recover itself, and a fatal syncope be induced. Then, again, death may result by their pressure on important parts, as on the bronchi or œsophagus; this, however, rarely occurs, unless it be that a sacculated aneurism, springing from the fusiform one, has given way. When, however, the tubular aneurism of the arch of the aorta occupies the intrapericardial portion of the vessel, it not unfrequently happens that, owing to the absence of an external coat in this situation, the artery may rupture at this point. It most commonly happens that a fusiform aneurism remains in a quiescent state, being a source of discomfort, but not of death, to the patient, until the sacculated form of the disease spring from its side, and that this becoming the more formidable affection, may destroy life in some of the ways peculiar to it.

2d. *Sacculated aneurism.* — By the sacculated aneurism is meant a tumor that springs from the side of an artery or of a tubular aneurism, with the interior of which it communicates by a narrow aperture, called the mouth of the sac. It is generally divided into the *true* and *false* varieties. By the *true* sacculated aneurism is meant a partial dilatation of all the coats of the vessel; by the *false* sacculated aneurism the dilatation of one, or at most of two coats, with the rupture of the others.

The existence of *true sacculated aneurisms* has been denied; thus, Scarpa doubts the occurrence of such a disease, and Bizot seems disposed to coincide with him. With these eminent pathologists, however, I cannot agree, and though I am willing to admit that many of the so-called true aneurisms are not so in reality, yet I cannot doubt, from repeated observation, that Hodgson is right in saying that in their early stages aneurisms are not unfrequently of the true kind. Thus, we occasionally meet, as Dr. Peacock has pointed out, with small digital pouches springing from the walls of some of the larger arteries, through the whole of which the external, middle, and internal coats can be demonstrated by maceration to exist; and in those aneurisms which are formed by the dilatation of a comparatively large portion of the arterial wall, it not unfrequently happens that the tumor remains of the true kind for some time, as I have had occasion more than once to ascertain by careful dissection. But after an aneurism has attained a certain size, its coats become so fused together, and so closely incorporated with the neighboring tissues, that their precise structure cannot be made out. Indeed, for a sacculated aneurism to be of the *true* kind, I believe that two conditions are necessary: 1st. That the tumor itself be small; and, 2d. That the mouth of the sac be of tolerably large dimensions. Porter says that he has never met with a true aneurism larger than a small orange, and, certainly, none of those that I have seen, provided they were of the sacculated kind, have exceeded this size. In true sacculated aneurisms, also, it is necessary that the mouth of the sac, or that portion of it which communicates with the interior of the artery, should be of a good size, and not bear too great a disproportion to the wall of the tumor. I cannot conceive a large

sac with a small mouth to be a true aneurism, for, as the mouth of the sac corresponds exactly in size to that portion of the arterial coats which have been originally dilated, it is not easy to understand how a large sac can be expanded out of a small segment of the wall of the artery; though, as in all cases of true aneurism, however small they may be, the size of the sac greatly exceeds that of its mouth, it is clear that there must have been, not only expansion, but a degree of hypertrophy and overgrowth of the wall of the vessel, just as in the tubular aneurisms.

By *false sacculated aneurism* is meant that variety of the disease in which the internal, or the internal and middle coats, have been ruptured, and are consequently deficient. These are by far the most frequent forms of sacculated aneurism, and are those which are met with of so great a size. In by far the majority of these cases, the internal coat and the innermost layers of the middle coat have been destroyed by atheromatous degeneration, leaving an erosion or depression in the interior of the artery, with weakness of the corresponding portion of its wall, which becomes expanded by the outward pressure of the blood. In these cases the sac is principally formed by the expansion of the outer coat, to which some of the layers of the middle may still be adherent; but which is essentially strengthened and thickened by plastic deposits, and by adhesions to neighboring parts, which have fused into its composition. In these cases there is outgrowth, hypertrophy, and new deposit in and upon the external coat, as is evidenced by its actually becoming thicker, instead of its being thinned, as it would be were it only expanded. The formation of an aneurism by the herniary protrusion of the internal and middle coats through an ulcerated aperture in the external coat, has been described; but though there is a preparation in the Museum of the College of Surgeons, that is supposed to illustrate this fact, I doubt the existence of such a form of the disease, and after careful examination think that the preparation in question looks rather like an artificial dissection, than a true rupture of this dense and elastic coat.

A false aneurism may always be readily distinguished from a true one, by the greater magnitude that it attains, by the size of the sac being out of all proportion to that of its mouth, and on a section of this being made, by the middle coat being seen to terminate abruptly in a thick and dense ring immediately around the mouth and neck of the sac. A false aneurism may either be so from the very first, the internal and middle coats having been destroyed by softening and erosion, and the external expanded and hypertrophied into a sac; or it may originally have been a true aneurism, some of the coats of which having given way, the conversion into the false variety of the disease has taken place.

Surgeons generally recognise two varieties of false aneurism, the *circumscribed* and the *diffused*. By the *circumscribed false aneurism*, is meant that form of the disease in which the blood is still contained within a sac, formed by at least one of the arterial coats, however expanded and altered in its structure this may be. The *diffused* form of *false aneurism* includes two distinct varieties of the disease. In one case there is rupture of the sac, and general and wide-spread extravasation of blood into the cellular tissue of the limb or part. In the other case it happens that the sac formed by the dilatation and hypertrophy of the outer coat of the artery is ruptured, and the blood, although effused beyond this, is still confined in a sac of condensed cellular tissue, formed by the matting together with coagulum and lymph of the structures into which the blood has been effused.

3d. The *dissecting aneurism* is a remarkable form of the disease, originally described by Mr. Shackleton, in which the sac is situated in the wall of the artery between its coats. It originates in consequence of the internal coat of the vessel becoming eroded, and giving way before any of that adhesion and matting together of the tissues around the patch has taken place, which pre-

vents the blood being forced between the different tunics of the artery. The rupture, although originating in the internal coat, always extends between the layers of the middle one, splitting this up into two laminæ, and in some cases it also separates the middle from the external tunics of the vessel. On examining the artery in a case of dissecting aneurism, its coats will always be found to be easily separable from one another, and to be very lacerable, often appearing soft and sodden as if macerated. For the production of this disease, indeed, two conditions are necessary. 1st. That there be atheromatous disease of the artery, destroying a portion of the internal and of the innermost layers of the middle coat; and 2d. That there be not only a want of plastic matter effused about the diseased part of the vessel, but also a general softening of the tissue of the middle coat, with want of cohesion between the different tunics of the artery; this indeed may be considered as the essential condition that disposes to the formation of a dissecting aneurism, and that causes the disease to assume this, rather than the sacculated form.

The rupture constituting dissecting aneurism always takes place longitudinally along the middle coat, and may often extend to a very considerable distance. Thus it may reach from the arch of the aorta to the iliacs, or from the same part to the bifurcation of the carotids. The disease only occurs, however, in the aorta, and in its principal branches; in those arteries indeed in which the middle coat is highly developed, and the yellow elastic tissue abundant.

These dissecting aneurisms arrange themselves into three distinct classes. 1st. Those in which the blood, after having passed for a distance of several inches, or even more, through the substance of the middle coat, bursts through the external coat, and becomes effused into the cellular tissue outside the vessel, and around the seat of rupture, or into the neighboring cavities. In these cases, which constitute the most common variety of the disease, death usually rapidly occurs, the patient feeling intense pain along the line of rupture, and falling into a state of syncope. 2d. The external coat may become so thickened and strengthened by the deposit of plastic matter, that it resists the impulse of the blood, which consequently continues to pass between the layers of the middle coat, until it meets a softened and atheromatous patch, and then again bursts into the canal of the artery. In this class of cases the patient may live for years after the occurrence of the rupture, the new channel that the blood has taken becoming lined with a dense smooth membrane, and resembling closely the interior of the artery, from which, however, it is separated by a kind of septum or mediastinum. The appearances presented by the vessel in this form of the disease have occasionally been erroneously described as constituting a double aorta. 3d. The blood may find its way between the laminæ of the middle coat, but does not escape again by rupture of the external, or by the giving way of the lining membrane of the vessel. A sac is consequently formed in the substance of the middle coat, which may become chronic, but will at last give way by external rupture.

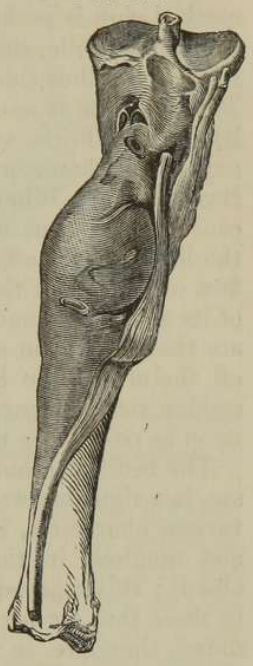
The progression of changes leading to the formation of an aneurism is consequently briefly as follows:—The coats of the artery undergo fatty degeneration, and atheroma is deposited at one part; this softens, and the lining membrane covering it, with perhaps a portion of the inner layers of the middle coat, becomes eroded; or the walls of the vessel may be weakened at this point without any destruction of their coats. Cohesion, however, takes place between the tissues of the vessel at the eroded or weakened spot; and the outer coat becomes strengthened and thickened by the deposit of plastic matter. Dilatation next takes place at this point; if of the entire coats, a *true* aneurism is formed; if of the eroded tunics, a *false* aneurism occurs: but if no cohesion have previously taken place between the different coats of the vessel, the blood becomes effused into and between them, thus constituting a *dissecting* aneurism.

Structure of an aneurism. — An aneurismal sac, if it be composed of a dilatation of all the coats of an artery, may be recognised on dissection by the atheromatous and calcareous deposits which are met with in the tissues of which it is composed. If it be a false aneurism, it will be found that there is little, if any, of these deposits in the walls of the sac, that the middle coat usually terminates abruptly at its mouth, and that the external coat is greatly thickened and strengthened by the deposition of plastic matters. Aneurismal sacs may vary in size from tumors not larger than a cherry, to growths the magnitude of a cocoa-nut or large melon. The mouth, which is oval or round in shape, varies greatly in size, being always very small in proportion to that of the sac. Usually the interior of an aneurismal sac contains a quantity of decolorized fibrine, arranged in concentric laminæ of but moderate thickness; these laminæ of fibrine are of a pale-buff color, dry and somewhat brittle where they are most closely applied to the wall of the sac; the more external ones appear to be those that are first formed, and occasionally are found to have undergone a kind of atheromatous degeneration; as we approach the interior of the vessel, they become softer and more colored; and, at last, in the central portions dark masses of coagulum are often met with. This decolorized fibrine appears to proceed from two sources; it is partly deposited from the blood which is beaten up in the interior of the sac, and thus deposits its fibrine much in the same way as when it is whipped in an ordinary vessel; this is probably the manner in which the principal masses are deposited. In some cases, however, it would appear as if it were formed by deposition from the wall of the aneurism; for the mass not being out of the current of the circulation, cannot well have been deposited from the blood, but must in all probability have been the result of the effusion of plastic matter from the wall of the sac; under these circumstances there is little or any of that stratified arrangement that is so observable in the fibrine that is deposited from the blood. The black coagulum that is occasionally met with in the middle of aneurisms differs in every way from the laminated fibrine just described, and is evidently the result of simple coagulation. The use of the deposited fibrine appears to be in a great measure to strengthen the walls of the sac, and thus to prevent the too rapid increase of the tumor. Another great purpose that it serves is to lessen the capacity of the sac, and thus to diminish the distending force of the blood which is injected at each stroke of the heart; the outward pressure depending as much on the area of the sac as on the force with which the blood is driven into it. Then, again, the lining of the walls of the sac with such a tough and elastic material as the stratified fibrine, must greatly tend to deaden and break the force of the shock of the wave of blood that is projected against what would otherwise be an unprotected and expanded membrane. In those cases in which the laminated fibrine is small in quantity or altogether deficient, the aneurismal tumor rapidly increases, with a forcible pulsation that is not met with under other circumstances.

Pressure-effects. — As the sac of an aneurism enlarges it exercises injurious and often fatal effects by its pressure upon contiguous parts. These *pressure-effects* deserve attentive consideration and study, as they constitute an important, and, in some instances, the sole element in the diagnosis of the existence of this disease. The compression exercised upon the veins not unfrequently gives rise to narrowing, or even complete obliteration, of the largest of these; thus occasioning œdema of the parts from which they take their origin, a varicose and greatly enlarged condition of the subcutaneous veins, and in some cases even gangrene of the limb. The pressure of the sac, also, on neighboring arteries, or even on the upper part of the very vessel from which it springs, and its interference with the general capillary circulation of a part, is commonly associated with the venous compression, and may considerably increase the ill-consequences resulting from it. The pressure upon a neighboring artery may go

on to perforation of the vessel by the sac, and so a communication may be set up between the aneurismal sac and a neighboring vessel; thus I have known an aneurism of the aorta perforate and communicate with the pulmonary artery. By its pressure upon neighboring nerves, an aneurismal sac may give rise either to great pain in, or to disturbance of, function of the parts supplied by them; the nerves themselves becoming, in some cases, expanded or flattened out, and ribbon-like (fig. 170), and in other instances rendered tortuous, waving, and being considerably elongated. This pain in the nerves is often one of the earliest signs of the existence of an aneurism. On the bones an aneurism may produce very important effects by its pressure, eroding or wasting away the osseous tissue in some instances, and in others giving rise to true caries. If the bone be a flat one, as the sternum, the aneurism may perforate it by making as smooth and round a hole in it as if this had been worked by the trephine. Organs and their ducts in the neighborhood of aneurisms suffer the most injurious effects from the pressure of these tumors, their functions being arrested, and the passage of their secretions interfered with; so, also, by the pressure exercised on the trachea and œsophagus, respiration and deglutition may be seriously impeded.

Fig. 170.



Flattening of posterior tibial nerve by pressure of an aneurism of the calf.

Aneurisms, though usually single, are not very unfrequently multiple. There may be more than one tumor of this kind in the same limb; thus the iliac and femoral arteries on the same side may both be affected. In other cases, corresponding arteries in opposite limbs are the seat of aneurism; thus, the two popliteals are not unfrequently found to be the seat of this disease, and occasionally an aneurism may take place in one of the limbs, and others in the arteries of the interior of the body. When more than one aneurismal tumor occurs in the same individual, the patient is said to be laboring under the "aneurismal diathesis." Numerous aneurismal tumors are at times met with in the same person; thus, Pelletan records a case in which no less than sixty-five were thus observed.

The *duration* of an aneurism varies very greatly. In young full-blooded persons it often makes progress with great rapidity, whereas, in elderly people, of feeble constitutions, or in those of a cachectic habit of body, accompanied with more or less debility of the heart's action, the disease may assume a very chronic form; thus, Hodgson relates the case of an aneurism of the femoral artery, of twenty years' duration. Much also will depend on the situation of the aneurism, the size of the mouth of the sac, and the relation of the sac to the impulse of the blood into it; the larger and more direct the mouth of the tumor, the more readily will the blood be projected into it at each impulse of the heart, and the more quickly will the tumor expand.

The *symptoms* of an aneurism are of two kinds: those that are peculiar to this disease, and those that are simply dependent on the presence of the tumor occasioned by the enlarged sac. The peculiar or pathognomonic signs are those that are dependent on the communication of the sac with the artery. They consist of signs afforded by the manual and auscultatory examination of the tumor. Those that are dependent on the mere size of the growth are the pressure-effects. It is of course only in external aneurisms that those signs that are ascertainable on manual examination of the tumor can usually be recognized. In internal aneurisms, in the majority of cases, the auscultatory signs and the pressure-effects afford the best indications of the presence and nature of the tumor;

though, when this approaches the surface, much information can be gained by palpation.

Symptoms of an external circumscribed aneurism. — The tumor is usually round or oval, distinctly circumscribed, and is situated upon, and in close connection with some large artery. It is at first somewhat compressible, but afterwards becomes more and more solid, as fibrine is deposited in it. The most marked sign is perhaps the pulsation that is felt in it from the very first. This is of a distensile, eccentric, and expanding character, separating the hands when laid upon either side of the tumor, by a distinct impulse from within outwards. The pulsation is more forcible in those aneurisms in which there is but little laminated fibrine, and as this increases in quantity it gradually loses its hard expanding character, being converted into a dead thud, and in some cases ceasing entirely. When obscure, the compression of the artery below the sac will cause it to become more distinct, or it may be increased in force by elevating the limb or part affected. When the artery above the sac is compressed, the flow of blood into the tumor is necessarily arrested, and a considerable quantity of its more fluid contents may be squeezed out by gentle pressure. If the hands are then laid upon either side of the tumor, and the pressure suddenly taken off the artery, the blood will be found to rush into and distend the sac by a sudden stroke, separating the hands from one another. This sign may be looked upon as one of the most characteristic of aneurism.

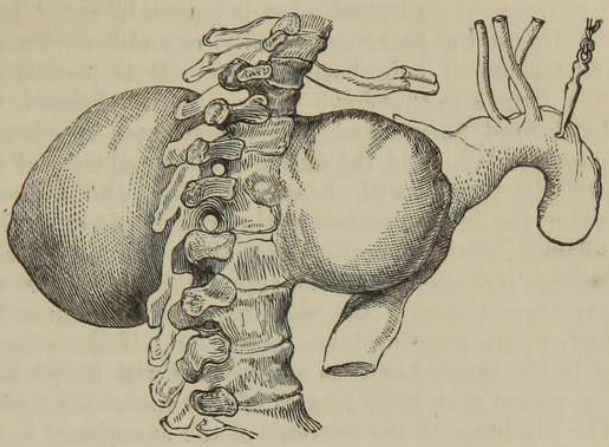
The bruit or sound emitted by the blood in its passage through an aneurismal sac, is a sign that was first noticed by Ambrose Paré. These sounds are of very various characters, being usually of a loud rasping or sawing nature; loudest and roughest in the tubular aneurisms. In many cases they are altogether absent; this especially happens in sacculated aneurisms with small mouths, or in those that are much distended with coagula and blood. The absence of any sound, therefore, in a tumor must not be taken as an indication of its not being an aneurism. The sounds are usually best heard in those tumors that are not too fully distended with blood; indeed they are usually more distinct when the sac is partially emptied of its contents. Thus, for instance, it not unfrequently happens that in an aneurism of the ham or thigh no bruit, or but a very faint one, is perceptible so long as the patient is standing up; but if he lie down, and elevate the limb so as to empty the sac, then it is very distinctly audible. Another sign of considerable importance consists in the diminution in the size of the tumor, and the cessation of the pulsation of the bruit in it, that occurs on compressing the vessel leading to the sac, and the immediate and sudden return of these signs on removing the pressure from the artery. All the symptoms that have just been described are peculiar to and characteristic of aneurism, being dependent on the communication that exists between the artery and the sac. Those that result from the pressure of the sac upon neighboring parts are common to aneurism and to any other kind of tumor; but though not of so special a character as those that have just been described, they are of considerable importance in determining the nature of the disease when taken in conjunction with the other symptoms.

One of the most common pressure-effects of aneurism is the occurrence of œdema of the limb or part, owing to the compression exercised by the tumor upon the large and deep venous trunks in its vicinity. The consequent obstruction to the venous circulation in the interior of the limb may also give rise to a distended or varicose condition of the subcutaneous vessels, and in some instances it may even go on to the production of gangrene.

The compression exercised by the tumor on neighboring nerves and tissues may, in many cases, be the cause of extreme suffering to the patient. The pain is usually of two kinds, either lancinating and radiating along the course of the nerve that is compressed, or, when the tumor presses severely upon neighboring

parts and tissues, more especially if it give rise to erosion of the bones as in fig. 171, an aching, burning, tearing, or boring sensation is often experienced in the part subjected to the pressure. In other cases again, important modifications in the function of parts take place, in consequence of the pressure that is exercised upon their nerves. Thus, for instance, the compression of the recurrent laryngeal will occasion hoarseness of voice and difficulty of breathing, depending on spasm of the glottis. Besides these more immediate effects, various remarkable symptoms may be produced by the pressure of aneurisms on different organs or mucous canals in their vicinity, and by the consequent interference with the function of these parts.

Fig. 171.



Symptoms of a diffused aneurism. — When an aneurism becomes diffused, the sac having given way, but the blood being still bounded by the tissues of the limb, the patient experiences a sudden and acute pain in the part, and usually becomes pale, cold, and faint. On examination it will be found that the tumor has suddenly and greatly increased in size, at the same time that it has lost its circumscribed and distinct outline. The limb may also become œdematous, or will suffer in other ways from the diffused effects of the pressure of the aneurismal swelling upon the neighboring veins and tissues. At the same time, the circulation in it being greatly obstructed, the limb may become cold and livid, and a sensation of weight and general inutility will be experienced in it. Under these circumstances the aneurismal swelling usually becomes harder, in consequence of the coagulation of the blood in the cellular tissue around the sac, by which indeed the further extension of the disease is arrested, and a fresh boundary is often formed, so as to limit the extravasated blood. If it be left to itself, the tumor will now usually rapidly increase in size, with much pulsation, and perhaps evidence of inflammatory action around it, so that at last it may so choke and obstruct the circulation through the limb as to occasion gangrene of it; or, if it advance towards the surface, external rupture of the sac will speedily ensue.

In other cases, again, it happens that when rupture of the sac takes place, the effused blood, instead of being limited by the surrounding cellular tissue, becomes suddenly and widely extravasated into the substance of the limb. When this untoward accident happens, the shock and local disturbance are very great, and the patient is suddenly seized with a very severe lancinating and numbing pain in the part. This pain is most severe in those cases in which the rupture takes place under the deep fasciæ, by which the effused blood is tightly bound down; and may be so severe as to occasion syncope. In other instances again, faintness occurs from the sudden loss of blood out of the current of the circulation into the substance of the part; the swelling being greatest in those instances in which the blood is suddenly and largely effused into the cellular tissue. If the extravasation happen in a limb, this will become greatly swollen, hard, brawny, and cold. The superficial veins are congested, and the circulation in the lower parts of the member is soon completely arrested by the pressure of the extravasated and semi-coagulated blood upon its vessels, more particularly

the larger venous trunks. In consequence of this, gangrene of a moist kind usually makes its appearance, and speedily destroys the patient's life.

Terminations. — *Suppuration* with *sloughing* of an aneurismal sac, is not of very frequent occurrence, but is especially apt to happen in those cases in which the disease has increased rapidly, or suddenly become diffused, with much heat and tension of neighboring parts. It is peculiarly likely to happen in tumors of a large size that have become partly diffused, that are filled with masses of decolorized fibrine, and that are situated in places where the cellular tissue is loose and lax, as in the axilla. The symptoms of this condition impending, are swelling, tension with heat, throbbing, and redness of the parts around the tumor, the integuments covering which, pit on pressure, and are evidently deeply inflamed, at the same time that there is a good deal of fever and general constitutional irritation. As the suppuration advances, the ordinary signs of congestive abscess occur; the skin covering the tumor becomes red and livid at one part, where pointing takes place; and if the surgeon make an incision into it, or if the tumor burst, as assuredly it will if left to itself, a quantity of sanious pus mixed with large masses of broken-down coagula and fibrine will be let out. The discharge of the contents of the aneurismal sac disintegrated by, and mixed up with the results of suppurative action, may be followed by so profuse a gush of arterial blood that the patient is suddenly exhausted. Most commonly, however, no immediate arterial hemorrhage occurs, but in the course of a few hours or days, as the deeper coagula are loosened, this sets in, and recurring from time to time speedily carries off the patient. In some extremely rare cases it has happened that the inflammation thus set up occludes that portion of the artery that communicates with the aneurismal sac, and that thus a spontaneous cure results by its obstruction, and by the adhesive inflammation of the vessel.

The *spontaneous cure* of an aneurism is a matter of very rare occurrence. The manner in which it happens has been especially and ably studied by Mr. Hodgson, and more recently by Dr. Bellingham, and the pathology of this process is of considerable interest from its bearing upon the cure of the disease by surgical operation. The spontaneous cure of an aneurism, as has already been stated, may accidentally, though very rarely, occur by the inflammation of the tumor and consequent obliteration of the artery; but this is not the way in which it has most frequently been found to happen. It is by the gradual deposition of laminated fibrine in the interior of the sac that it is filled up completely. This process can only take place in arteries of the second or third magnitude, and never in aneurisms of the aorta; and can only happen in the sacculated aneurisms, the fusiform not admitting of it, it being necessary that the blood flowing through the sac be somewhat retarded in its passage, so as to give time for the deposit of its fibrine upon the interior of the tumor. This process, which is a very different one to the coagulation of the blood, is an increase of a natural condition always going on in the sac. In all cases of sacculated aneurism, there is a tendency to the production of a spontaneous cure, though this is so rarely accomplished. The tendency to it takes place by a contraction and partial occulsion of the artery *below* the sac, and the consequent diminished force of the circulation through it, by which the deposition of fibrine is greatly increased, at the same time that the collateral vessels given off *above* the sac often enlarge to a considerable extent, and thus divert blood away from it that would otherwise have passed through it. This condition of the vessel below the sac, may be looked upon as the first and most important step towards the consolidation of the tumor. The process is also materially assisted by the mouth of the sac being small, and so situated that the blood cannot be directly driven into it.

For the spontaneous cure to take place, it is however necessary that the current of blood should continue to circulate through the sac. If it be suddenly arrested, coagulation of the blood which happens to be in the sac, may take

place in its interior, which thus becomes filled with a large dark soft clot of blood; but the essential element in the consolidation of the tumor, the deposition of stratified fibrine, does not take place in this way; the sudden formation of the dark coagulum, which acts as a foreign body, is indeed apt to induce suppuration and sloughing of the sac and neighboring tissues, hence it is rather prejudicial than otherwise. But though the blood continue to circulate through the sac, the deposit of fibrine will not take place unless the impetus with which that fluid is sent into and through the tumor is considerably diminished. This may happen from some or other of those conditions occurring in the distal portion of the artery or the mouth of the sac that have already been described. So also it has been found that in those cases in which two aneurisms are situated upon one artery, the second or distal one is very apt to undergo partial or even complete consolidation, the blood losing its impetus in its passage through the first sac. Any constitutional cause or condition also, by which the impulse of the heart is lessened, and the force of the flow of blood through the sac diminished, as the occurrence of phthisis, for instance, will favor greatly the deposit of laminated fibrine, and the consolidation of the tumor.

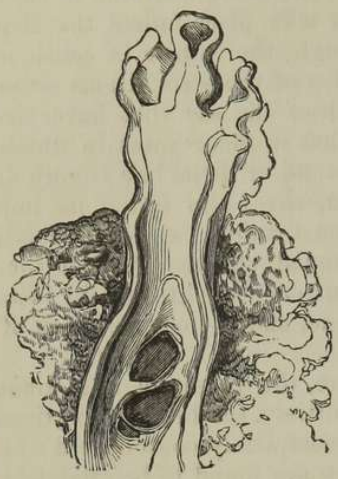
As the aneurism undergoes spontaneous cure, the pulsation in it gradually becomes more and more feeble, until it ceases entirely, the bruit proportionately lessens, the tumor becomes harder, and at last completely consolidated; at the same time, the anastomosing circulation is sometimes found to be established in some of the collateral vessels of the limb. Eventually, the solidified tumor shrinks in size, undergoing a species of drying and absorption, with ultimate conversion into a small mass of fibro-cellular tissue.

An aneurism may *prove fatal* in various ways. It does so when internal, most frequently by the pressure that it exercises on parts of importance in its vicinity, the patient being destroyed by the exhaustion induced by interference with their functions; this is usually the way in which aneurisms of the aorta occasion death. Then again, death may result by the occurrence of syncope, more especially if the aneurism be of large size, and situated near the root of the aorta. External aneurisms most commonly prove fatal by rupture of the sac; this may either take place into the interior of a limb, giving rise to one or other of the diffused forms of aneurism, that have just been described, and terminate fatally by the induction of syncope or gangrene; or they may kill by rupture occurring on one of the surfaces of the body. When an aneurism is about to burst upon the surface, the skin covering it becomes inflamed; at the most prominent point a slough forms, by a process somewhat analogous to that of the pointing of an abscess; as this loosens and separates, trickling of blood occurs, an occasional gush takes place, usually after coughing, or any exertion, and the patient is exhausted by these repeated hemorrhages. In other cases again, a sudden and forcible gush is immediately fatal on the loosening of the slough. On the mucous surfaces, as of the œsophagus or trachea, rupture occurs in a similar manner (fig. 172). On the serous surfaces, as into the pleura and pericardium, the aneurism may burst by a fissure or stellate opening (fig. 173) forming in this membrane. The rupture of an aneurism is not always immediately fatal, the aperture in the sac being plugged up by a mass of coagulum, as happened in case fig. 172, which may not be loosened for some time, and through which the bleeding recurs in small quantities at intervals. An aneurism has been known to give way and discharge blood for some weeks before it proved fatal, and it may even happen that after the rupture has occurred, no hemorrhage may take place, but death result from the pressure of the tumor. Thus, in the case of the late Mr. Liston, the sac of the aneurism which caused the death of that great surgeon, had actually given way, a mass of coagulum projecting from it into the trachea, but yet death resulted by the

irritation induced from pressure upon the inferior laryngeal nerve, and not by hemorrhage.

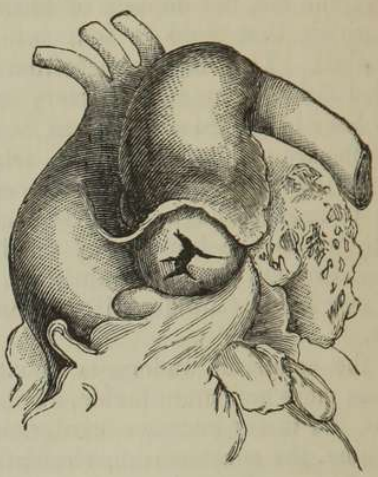
The *diagnosis* of aneurism may in many cases be effected with the greatest possible ease; in other instances again, it requires a vast amount of care to

Fig. 172.



Aperture in œsophagus produced by pressure of an aortic aneurism.

Fig. 173.



Stellate rupture of an aortic aneurism into pericardium.

come to a correct conclusion as to the nature of the tumor. This is easily done when the aneurism is superficial, recent, and circumscribed, the blood in it being fluid, and all the signs of the disease well marked. It is often replete with difficulty when the aneurism is deep seated, or if external, when old and filled with coagula; or if suppurative action has taken place about it, or if it has become diffused.

In effecting the diagnosis of aneurism we have, in the first place, to ascertain the existence or not of a tumor, and after this has been done, to ascertain whether it is aneurismal or of some other character. This point is most difficult to determine in internal aneurisms; in the external, this difficulty cannot exist, for the doubt here is not as to the presence of a tumor, but as to its nature. The tumors with which aneurisms may be confounded may conveniently be divided into two classes, those that do and those that do not pulsate.

1st. *Every pulsating tumor is not an aneurism.* — Thus there may be pulsation in various kinds of encephaloid tumors, or in growths composed of erectile tissue. In such cases as these, many of the signs of aneurism are present; thus the size of the tumor may be diminished by compression, and the distinct influx of blood into it may be felt again on the removal of the pressure, the tumor returning to its original size with a soft swelling pulsation; there may also be a bruit, often of a loud and distinct character. But these tumors may generally be distinguished from aneurisms, in not being quite so distinctly circumscribed, in being soft, spongy, and elastic, without the sensation of fluid that is met with in some forms of aneurism, or the solid coagula that occurs in others. Then again the bruit is either of a soft, blowing, and more prolonged character, or else sharp and superficial; the pulsation, also, is not so distinct, and is more of the nature of a general swelling and heaving of the tumor, than of a distinct thump. Much light is also occasionally thrown upon these affections by their being met with in situations where aneurisms cannot occur from the absence of any arteries of sufficient size to give rise to it; as for instance, on the head of the tibia, or the side of the pelvis; but if it so happen, that a tumor of this kind is situated upon or under a large artery in

the usual site of an aneurism, then the diagnosis is certainly replete with difficulty, and cannot indeed in many cases be made. Several instances have of late years occurred, in which surgeons of the greatest skill and experience have ligatured arteries, on the supposition that they had to do with an aneurism, when in reality it was one of the pulsating tumors just described, that closely simulated it.

Pulsation may be communicated to a tumor of a fluid character, seated upon an artery; here the diagnosis, though often difficult, is more readily made than in the last case. Attention to the history of the case, to the impossibility of diminishing the tumor by pressure, either directly upon it, or on the artery leading to it, its fluctuation, and want of circumscription will usually point out its nature. Especial attention should likewise be paid to the fact that the pulsation is a distinct heaving up and down of the tumor, and neither eccentric nor distensile, and that the swelling may often be wholly or partly separated, by raising it up, from the artery lying beneath it. By attention to these points, abscesses in the axilla, under the pectorals, at the root of the neck, and in other situations where pulsation may readily be communicated to the fluid mass, can be distinguished from aneurism; but yet errors in diagnosis have happened, and will continue to do so from the intrinsic difficulty of these cases, and from no want of skill or care on the part of the surgeon: and those will be most charitable in their criticisms on the mistakes of others, who have most frequently had occasion to experience these difficulties in their own practice.

2d. *Tumors that do not pulsate* either by their own vessels, or by those that lie beneath them, are not so readily confounded with aneurism as the class of affections that has just been described. But yet it must be borne in mind, that in some instances aneurisms even do not pulsate, or but very indistinctly so, having become filled with a dense and firm coagulum. The non-pulsating tumors that chiefly require attention are glandular, scirrhous, or ganglionic swellings, seated over the carotid artery, at the root of the neck, or in the popliteal space. If these be of a fluid character, their fluctuation, unvarying size, and the want of pulsation in them sufficiently indicate that they are not connected with the artery, from which they may also frequently be separated, and upon which they may be distinctly moved. If solid, they are usually irregular and nodulated on the surface, and can frequently be detached by the fingers being passed underneath them, and raising them from the subjacent vessel. I believe there is more danger of mistaking a consolidated aneurism which is undergoing or has undergone spontaneous cure, and in which there is consequently no pulsation, for a solid, perhaps a malignant tumor of some kind, than the reverse. I have known one instance in which the thigh was amputated for a very painful solid tumor of the popliteal space which proved on dissection to be a consolidated aneurism, pressing upon the posterior tibial nerve (fig. 163).

With *rheumatism* it would at first appear to be difficult to confound an aneurism, but in practice it is not so. I have known several cases in which the lancinating pains of aneurism, more especially when the tumor was internal, have been mistaken and treated for rheumatic affections; and I have even known the pain occasioned by the presence of a large aneurism of the thigh treated for several weeks as rheumatism. In such cases as these, it is of course obvious that a little care and proper examination will usually serve to establish the diagnosis. The aneurismal may be distinguished from the rheumatic pain by its having a twofold character, being both lancinating and intermittent, as well as continuous aching, and burning. When this kind of pain is persistent, especially about the back, the side of the head and neck, or arm, it ought always to cause the surgeon's attention to be directed to the condition of the neighboring large vessels.

The *causes* of aneurism are divisible into those that predispose to, and those that excite, the disease. Aneurism is predisposed to by any affection of the arterial coats that lessens the elastic resiliency of the vessel, and at the same time weakens its resisting power. The affection that we have already seen does this to the greatest extent, is the fatty degeneration of arteries, or atheroma; under the influence of this condition, not only is the natural elasticity lost, but the walls are so softened that they are readily expanded, either uniformly, or dilated at one side. Though calcification destroys the elasticity of the artery, it at the same time makes it rigid and unyielding, and but little disposed to expand under the influence of the outward pressure of the blood.

Age exercises a powerful predisposing influence on the occurrence of aneurism. This disease is excessively rare before puberty, yet it is occasionally met with at early periods of life; thus Syme mentions a case of popliteal aneurism in a boy of seven, and Hodgson has a preparation of a carotid aneurism in a girl of ten. It is during the middle period of life, about the ages of thirty and forty, that aneurisms are most frequently met with; at those ages, indeed, when the arteries have already commenced to lose their elasticity, in consequence of disintegrating changes, whilst, at the same time, the heart has not lost any of its impulsive force, or the general muscular system its contractile vigor; and when the weakened and inelastic vessels becoming exposed to powerful causes of distension, may readily give way and be expanded at some one weakened point. A forcible, irregular, and occasionally greatly increased action of the heart, is the immediate cause of the over-distension and dilatation of the vessels, and thus of the production of aneurism. Hence, we find that this disease is especially apt to be induced in those individuals in whom the muscular system is called upon to make sudden, violent, and intermittent exertions; as, for instance, in men who habitually lead somewhat sedentary lives, occasionally and suddenly changing their habits, and indulging in sports, which they might without risk have practised in early life, such as hunting, rowing, or a long day's shooting; but which cannot be taken up with impunity at an age when the arteries, having become weakened, are unable to bear the same strain upon their coats as heretofore. I agree with Mr. Porter, in thinking that continuous, steady, laborious employments do not predispose to aneurism, as this disease is seldom met with amongst those of the lower classes, who labor hard and uninterruptedly, but it rather occurs in those who, after long periods of comparative inaction, are occasionally and suddenly called upon to make very violent muscular efforts, disproportioned to their strength, or, at all events, to their previous habits. It is in this way that soldiers, sailors, and members of the higher classes in society, are rendered peculiarly liable to aneurism. As violent muscular exertion predisposes to this disease, we should necessarily expect to meet with it more frequently among men than in women; and accordingly, Dr. Crisp finds that of 551 cases of aneurism of all kinds, more than seven-eighths occurred in men. It is important, however, to observe that different kinds of aneurism occur with varying degrees of frequency in the sexes; thus, this affection of the carotid artery is met with about as often in women as in men, whilst the other external aneurisms occur in the proportion of 13 cases in males to every one that happens in a female. It is remarkable, however, that in the dissecting aneurism the proportions are reversed, and for every 1 case in men, 2 occur in women.

Climate exercises an important influence on the occurrence of aneurism, which is far more frequent in cold than in hot countries. If we may judge of the prevalence of aneurism in a country by the number of published reports of cases, I should say that it is of more common occurrence in Great Britain and Ireland than elsewhere; indeed, Roux states that it is less frequent in France than in England. In America it is also of frequent existence, but in the East Indies it is rarely met with.

Cachexy induced by any cause, such as syphilis, chronic gout, or rheumatism,

the abuse of mercury, &c., has a tendency to occasion disease of the coats of the arteries, and thus to predispose to aneurism. But though mercury and syphilis are commonly said specially to tend to the production of this disease, I am not aware that we are in possession of any facts that would warrant us in coming to this conclusion; though there can be no doubt that the cachexy thus induced, may dispose to it equally as if it arose from any other cause. It is remarkable that phthisis is antagonistic to aneurism, though probably this may arise from the fact of the heart's action being feeble in this disease, and that violent muscular exertion is seldom undertaken by those laboring under it. Any obstacle to the free flow of blood through an organ or the capillaries of a part, exercises an important influence in disposing to aneurism, as it throws an increase of pressure on the interior of the artery. Dr. Chevers believes that obstruction in the abdominal organs frequently occasions aneurisms of the abdominal arteries.

The only exciting or direct occasioning causes of aneurism are blows, violent strains, and wounds of an artery. When an atheromatous artery is concussed by a blow, the lining membrane covering the softened patch may be ruptured, the atheroma being poured out into the interior of the vessel, and thus the external coat, with perhaps a portion of the middle adherent to it, becoming exposed to the pressure of the contained blood before it has been fully consolidated by inflammation and plastic deposit, the foundation of an aneurism may readily be laid. In very violent muscular strains or efforts an artery may occasionally be completely torn across, and it is easy to understand how, under these circumstances, the increased pressure that is thrown upon its interior may give rise to dilatation of an already weakened portion of the vessel. Wounds implicating arteries, are common causes of those various forms of aneurism that have already been discussed in considering injuries of arteries.

TREATMENT OF ANEURISM.

The *treatment* of aneurism is of two kinds — constitutional and local. In many cases, as in the various forms of internal aneurism for instance, the constitutional treatment can alone be employed, and in all cases of external aneurism it should be had recourse to as an important adjunct to any local measures that are adopted. In the *constitutional* or *medical treatment* of aneurism, the great object is to bring about the same condition as that by which the spontaneous cure of the disease is effected; and, indeed, to put the patient and the part in the most favorable state for nature to consolidate the tumor; and though it may not be possible in the great majority of cases to effect a cure in this way, at all events the disease may be palliated, and its progress retarded. The sacculated is, however, the only form of aneurism that can ever be cured by constitutional means; in the fusiform variety, all that can be done is to regard the progress of the case.

In the *constitutional treatment* of aneurism the principal objects to be held in view are, in the first place. to lessen the force of the heart's impulse, so as to diminish the eccentric pressure upon the arterial coats; and, secondly, so to modify the condition of the blood as to dispose it to the deposition of its fibrine. In carrying out these indications, it should be borne in mind that there are two opposite conditions of the system in which aneurism occurs; in one there is a plethoric, and in the other an anemic tendency. The plethoric and irritable state of system chiefly occurs in young subjects, in whom the progress of the disease is acute and rapid, attended by much impulse and excitability of the heart, and throbbing of the arteries generally. The other condition of the system principally occurs in elderly people, in whom there is a feeble pulse, a quiet heart, a cachectic state of health, and a tendency to anemia; in such a habit of body the disease makes slow progress. In these opposite conditions

it is perfectly clear that the same plan of treatment cannot succeed; and that the constitutional means must accordingly be modified according to the state in which the patient is.

In the acute or hyperemic state, the plan of treatment originally introduced by Valsalva, and hence called by his name, by which plethora is removed, the irritability of the heart and the force of its action lessened, and the blood brought into a healthy condition, may be advantageously employed, in the modified manner that has been recommended and adopted by some modern surgeons. Pelletan and Hodgson especially report very favorably of this treatment, and I have seen several instances in which it has proved decidedly beneficial. As recommended by Valsalva, this method of treatment was intended to carry out two important points. 1st. By a process of gradual starvation and depletion to reduce the quantity of blood in the system, the power of the heart's action, and consequently the pressure exercised upon the walls of the aneurism; and 2d, after the patient had in this way been reduced, the plasticity of the blood was to be improved by feeding him up in a gradual and careful manner, so that the tendency to the deposit of laminated fibrine might be increased. Valsalva endeavored to carry out the first of these objects by subjecting the patient to small and repeated bleedings, and by gradually reducing the quantity of food that was daily taken, until it was lowered to half a pound of pudding in the morning, and a quarter of a pound in the evening. In this way the patient's strength was reduced until he could scarcely be raised up in bed without fainting; the quantity of food was then gradually augmented, so that the plasticity of the blood might be restored. It is seldom that surgeons carry out Valsalva's plan of treatment in the precise manner indicated by him; it is most commonly found to be more convenient to modify somewhat according to the circumstances of the case, though the principles on which it is conducted are essentially the same.

In adopting any constitutional treatment in cases of aneurism, the first and most essential point to be attended to is, to keep the patient perfectly quiet in bed and free from all mental or conversational excitement. The diet should at the same time be very carefully regulated, being gradually reduced in quantity, and being made to consist principally of farinaceous food, with but a very small quantity of meat, but little liquid, and a total absence of all stimulants. Perhaps the best regimen is that recommended by Bellingham, consisting of two ounces of bread and butter for breakfast, two ounces of bread and the same quantity of meat for dinner, and two ounces of bread for supper, with a little milk and water, occasionally sipped in small quantities. At the same time purgatives should be administered, especially such as give rise to watery stools, and which remove obstructions of the portal and renal systems; with this view ℈j. of the compound jalap powder may be given twice a week.

In some cases, if the heart's action be particularly strong, small bleedings may advantageously be had recourse to from time to time. By judiciously carrying out this plan of treatment and modifying it according to the circumstances of the case, consolidation of the aneurismal tumor may occasionally be looked for; or, if this be not attained, the progress of the disease will be very materially retarded.

When aneurism, however, occurs in feeble, cachectic, and anemic patients, this plan of treatment is altogether inadmissible: here, the blood being deficient in fibrine, and the system in an irritable state from debility, the best results follow such a course of treatment as will improve the plasticity of the blood, and regulate the action of the heart. With this view, complete rest, the administration of the preparations of iron, and the exhibition of a dry but nourishing meat diet, with the occasional employment of opiates to relieve pain and to quiet the system, will be attended by the best results. In aneurism occurring in

elderly people, and amongst the poorer classes, this plan of treatment is perhaps more successful than any other.

In the *local treatment* of aneurism but little can be done with the view of checking its progress, except by the employment of direct surgical means. The application of ice to the surface of the tumor is said to have acted beneficially in some cases, but it is a painful remedy, and one that may occasionally be attended by the inconvenience of sloughing of the skin to which it is applied. When the pain attending the increase of the tumor is considerable, much relief may be obtained by the application of belladonna plasters, or the use of an embrocation composed of equal parts of oil and of the strong tincture of aconite. These means comprise the only local measures that can be adopted in those cases of internal aneurism, which are beyond the reach of surgical interference.

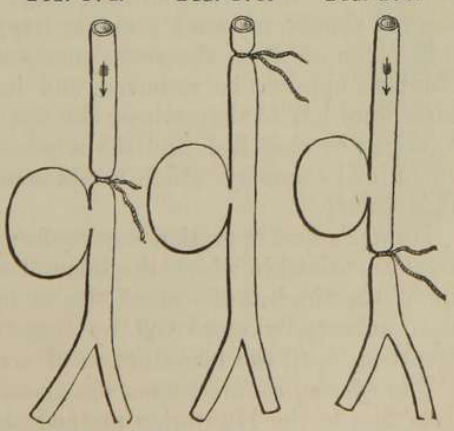
THE SURGICAL TREATMENT OF ANEURISM.

In all those cases in which it is possible to delay with safety, no surgical proceeding should be undertaken for the cure of aneurism until the patient has been subjected to proper constitutional treatment for some time; the success of the more direct surgical means depending greatly in the hyperemic forms of aneurism on the heart's impulse being lessened, and in the blood being got into as healthy a state as possible; whilst in the anemic form of the disease, an increase in the plasticity of the blood is essential for the cure of the case; for as the occlusion and consolidation of the sac, after surgical procedure, depend on the same conditions being induced that are successful after medical treatment, the same constitutional means should be adopted in one case as in the other. Before proceeding to the employment of any direct surgical means for the cure of an external aneurism, it is necessary to ascertain that there be no internal aneurism present, and that the heart is free from disease. From want of this precaution, it has happened that patients have died on the operating table at the moment that the artery was being ligatured, or that they have expired shortly afterwards, from the disturbance of circulation consequent upon the necessary surgical procedures.

Surgeons are in possession of several modes of treating external aneurisms, viz., by *ligature*, by *compression*, by *galvano-puncture*, by *injection* and by *manipulation*. The employment of the ligature was the only means adopted by surgeons, for the cure of aneurism, up to a very recent date; the use of compression, in the treatment of the disease, as at present employed, being one of the most modern, as well as one of the greatest improvements, in surgical practice.

The manner in which the ligature should be applied, and the various cautions respecting its use, have already been sufficiently discussed (page 164 *et seq.*) The question as to the part of the vessel to which it should be applied in cases of aneurism, however, remains for consideration, and this involves some important points.

FIG. 174. FIG. 175. FIG. 176.



There are three situations in which the ligature may be applied: 1st, *above and below the sac* by the old operation; 2nd, on the *cardiac side* of the sac, by Anel's (fig. 174) or Hunter's (fig. 175) operation; 3rd, on the *distal side* of the sac, by Brasdor's or Wardrop's operation (fig. 176). The application of the ligature to the artery on both sides of the aneurismal sacs, is seldom practised at

the present day, when the aneurism arises from disease of the coats of the vessel; but, in those cases in which it occurs from traumatic causes, it may frequently be adopted as the best means of cure. The older surgeons, however, were only acquainted with this mode of treating aneurisms. They slit up the sac, turned out the contained coagula and masses of fibrine, and then passing a probe upwards and downwards, into the artery, through the mouth of the sac, tied the vessel on either side, immediately above and below the aperture in it. This operation, when performed on any of the larger arteries, as the popliteal for instance, was not only so difficult in itself, that surgeons were seldom willing to undertake it, but was so fatal in its results, being so commonly attended by secondary hemorrhage in consequence of the artery being ligatured in a diseased part, or by diffuse inflammation, suppuration, and gangrene in the deeper tissues of the limb operated upon, that recovery after its performance was considered a marvel, and most surgeons preferred submitting the patient to amputation at once, than to the risks of so hazardous a procedure.

The ligature of the artery on the *cardiac* side of the aneurism, without opening the sac, was first done by Anel, in the year 1710, in a case of brachial aneurism. This operation, though attended with the risk of wounding or inflaming the sac, which was in close proximity to the seat of ligature, constituted a considerable advance in the treatment of the disease, inasmuch as it did not necessarily lead to the opening up of the aneurismal tumor, and to the attendant dangers that were inseparable from that mode of procedure. As Anel, however, performed his operation as a mere matter of convenience in a particular case, and without the recognition of any new principle of treatment being involved in it, it attracted but little attention at the time, and does not appear to have been repeated by any of the surgeons of his day.

It was reserved for John Hunter to make the great improvement in operative surgery of ligaturing the artery at a distance from the sac, where its coats were healthy, and where there was no danger of interference with the aneurism itself. In this way the objections to Anel's operation were avoided, for though, like Anel, Hunter tied the artery only on the cardiac side of the sac, yet he differed from him in doing so in a healthy part of its course, and at a considerable distance above the tumor, where the application of the ligature would be attended with less risk of hemorrhage, and with no danger of opening, irritating or inflaming the sac, which are inseparable from Anel's operation. The following are the reasons, given in Sir Everard Home's own words, that induced John Hunter to adopt the operation that is now generally known in surgery as the *Hunterian*. "Mr. Hunter proposed, in performing this operation, that the artery should be taken up at some distance from the diseased part, so as to diminish the risk of hemorrhage and admit of the artery being more readily secured should any such accident happen. The force of the circulation being thus taken off from the aneurismal sac, the cause of the disease would, in Mr. Hunter's opinion, be removed, and he thought it highly probable that if the parts were left to themselves, the sac, with the coagulated blood contained in it, might be absorbed, and the whole of the tumor removed by the actions of the animal economy, which would consequently render any opening into the sac unnecessary."

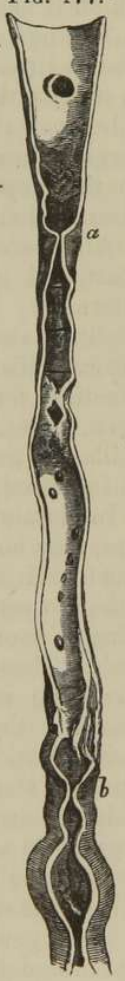
Hunter's first operation was performed in December, 1785, in a case of popliteal aneurism, in which the femoral artery was ligatured rather below the middle of the thigh, underneath the sartorious muscle; and since that time it has been universally employed by surgeons, as almost the only mode of treating aneurism, until the introduction of compression in 1842.

The *effects produced upon the aneurismal tumor* by the ligature of the vessel, according to the Hunterian method, deserve careful attention. The immediate effects, on drawing tight the ligature, consist in a cessation of pulsation and bruit in the tumor, which at the same time subsides, becoming partially emptied

of its blood. The supply of blood to the limb being in a great measure cut off, it becomes numb and cold, with a diminution of muscular power. The more remote effects consist in an increase of the activity of the collateral circulation, by which the vitality of the limb is maintained. At the same time, and, indeed, in consequence of this, the temperature of the limb often rises, until it becomes higher than that of its fellow.

The consolidation of the aneurismal tumor begins as soon as the ligature is applied, and is usually completed in a few days, by changes taking place within it similar to those that occur in the spontaneous cure of the disease. This important change is effected by the gradual deposit of stratified and decolorized fibrine in concentric layers within the sac, and not by the sudden coagulation of its contents. For this deposition to take place, it is necessary that, though the direct flow of blood through the tumor be arrested by the ligature of the main trunk, yet that some should be carried in by collateral channels. This is a necessary condition for the success of the ligature, for if it happen that all the flow of blood through the tumor be arrested, coagulation of that which happens to be contained in it will ensue, followed by gangrene, suppuration of the sac, and other unfavorable results; the coagulum appearing to act as a foreign body, and to be insusceptible of those changes that are necessary for the consolidation of the tumor. It is of importance to observe, that the proper consolidation of the aneurismal tumor, by the deposit of laminated fibrine, will occur even though a very considerable quantity of blood continue to flow through it. In the Museum of University College there is an exceedingly interesting preparation that illustrates this point; it is one in which Sir Charles Bell ligatured the femoral artery for popliteal aneurism. The patient died a week after the operation from erysipelas; on examination it was found, and is shown by the preparation, that the femoral artery was double, and that, though only one portion of the vessel had been ligatured, the tumor, which continued to be supplied by the other, was completely consolidated. Hence, it would appear that if one-half of the influx of blood only be arrested, obliteration of the sac by deposition of laminated fibrine may be expected to occur. After the aneurismal sac has been thus occluded, it progressively diminishes in size, and is at last converted into a small fibro-cellular mass The artery that has been ligatured becomes closed at two points — at the part deligated (fig. 177 *a*), and where it communicates with the sac (fig. 177 *b*). In both these situations, it will be found to be converted into fibro-cellular tissue, whilst between them there is an open space, through the medium of which the collateral circulation is freely carried on.

FIG. 177.[1]



Distal Ligature.—In some cases in which the ligature cannot, for anatomical reasons, be applied on the proximal side of the aneurism, as in the arteries about the root of the neck, it was recommended by Brasdor that an endeavor should be made to obliterate the aneurism by ligaturing the vessel on its *distal* side. This operation was first practised by Deschamps, and has been especially commented upon by Wardrop. In principle, it resembles the Hunterian operation, the object being to arrest so much of the flow of blood through the sac, that the consolidation of this may take place in the usual way, by the deposit of laminated fibrine. In the Hunterian operation, this is effected by

[1] Femoral artery ligatured for popliteal aneurism, obliterated at *a*, the site of the ligature, and at *b*, where the tumor has become consolidated and absorbed — between these points the artery is open.

deposit from the lessened quantity of blood that flows through the sac; and, in the distal operation, it is sought to be accomplished in the same way, and the success of the operation must necessarily depend, in a great measure, upon the extent to which the flow of blood through the sac is interfered with. These operations, however, are rarely successful, for, independently of the ordinary dangers resulting from the application of the ligature to a large vessel, the sac will continue to be distended with and to receive the direct impulse of the blood that is driven into it, though it be not transmitted through it; and hence, though the progress of the aneurism may be arrested for a time, it will often speedily increase again, and may perhaps eventually destroy the patient by suppuration and sloughing. I have collected the details of 27 cases in which this operation has been practised, and of these I find that in 20 instances a fatal result speedily followed the operation; whilst in the remaining 7 cases the patient survived the effects of the ligature of the artery, though he was not at all cured of the disease for which the operation was practised. This operation, however, we shall consider more in detail in speaking of the particular cases in which it has been practised.

The ligature of the artery for aneurism, by the Hunterian method, succeeds best in those cases in which the tumor is circumscribed, of moderate size, slow in its growth, having a tendency to consolidation, and unaccompanied by much œdema of the limb. When the aneurism is undergoing spontaneous cure, no surgical interference should be had recourse to, but the case left to nature. In this way it occasionally happens, during the preparatory treatment of the disease, that the aneurism becomes consolidated.

All operations should be avoided when there is any serious disease in the heart, and in cases of multiple aneurism where the second tumor is situated internally; but it has happened that two aneurisms in one limb, as of the popliteal and femoral arteries, have been cured by one ligature applied to the external iliac. Two aneurisms seated in corresponding parts of opposite limbs, affecting, for instance, the two popliteal arteries, may be successfully operated upon. But, if two aneurisms be seated on different parts of the body, as the axilla and groin for instance, at the same time, the aneurismal diathesis would be indicated, and it would certainly not be expedient to operate.

In certain cases, the Hunterian operation seldom succeeds, and these, therefore, may be considered as unpromising to it. This happens in those instances in which it is necessary to apply the ligature very close to the sac, so as indeed rather to perform Anel's operation, as here there is the double danger of inflaming or wounding the sac, and of interfering with the collateral circulation of the limb. Those cases again, in which the aneurism is very acute in its progress, increasing rapidly with forcible pulsation, having very fluid contents, a large mouth to the sac, and consequently the blood driven into it by a full wave at each pulsation of the heart, are rarely favorable for the use of the ligature, inasmuch as stratification seldom occurs. When the aneurism is situated in the midst of loose and very yielding tissues, as in the axilla, where it readily expands to a large size, not being bound down by the surrounding parts, suppuration and sloughing of the sac are especially apt to occur after the ligature. When it is diffused widely through the limb, with coldness and a tendency to incipient gangrene, the circulation of blood through the part is so much choked that the deligation of the vessel will in all probability arrest it entirely, and thus produce mortification. When arteries can be felt to be ossified, it is a question whether they can be safely ligatured, as in all probability they will be cut or broken through by the noose, and the changes necessary for their occlusion would not take place. Porter, however, recommends that the ligature should be applied in such case, though I cannot but doubt the propriety of this advice. When inflammation has been set up in the sac, with a tendency to suppuration of the tumor, it is a debateable question whether the ligature should

be applied or not. In these cases I agree with Hodgson, that the artery should be tied; for even if the sac eventually suppurate, there will be less risk to the patient, if this event occur after the application of the ligature, than if it happen when the artery leading into the tumor is pervious.

In some instances, there is no resource left to the surgeon, but to amputate. This is the case when the aneurism is associated with carious bone, or diseased joints, as when the popliteal aneurism has given rise to destruction of the knee. If the aneurism have attained so great a magnitude that it has already interfered seriously with the circulation through the limb, as indicated by considerable œdema, lividity, and coldness of the part, with distension of the superficial veins, it is a question whether the application of the ligature may not immediately induce gangrene, and whether the patient would not have the best chance of recovery by submitting to amputation at once; this is more particularly the case when the aneurism has become diffused with impending gangrene, when removal of the limb must not be delayed.

The ligature fails from various causes in a very considerable number of the cases in which it is employed for the cure of aneurism. Thus in the 256 cases of ligature of the larger arteries for aneurism, that have been collected and tabulated by Dr. Crisp, it would appear that the mortality amounted to about 22 per cent. And Porta finds that out of 600 cases of ligature of arteries for diseases and injuries of all kinds, the mortality amounted to 27 per cent. It must be borne in mind, that these are collections of previously reported cases, and that if the unrecorded cases could be got at, the rate of death would, in all probability, be found to be much higher even than that above stated.

ACCIDENTS AFTER LIGATURE FOR ANEURISM.

The accidents that may follow the application of the ligature in a case of aneurism, are: 1st, secondary hemorrhage from the seat of ligature; 2d, the continuance, or the return of pulsation in the sac; 3d, the occurrence of suppuration and sloughing of the tumor, with or without hemorrhage from it; and, 4th, gangrene of the limb.

1st. Secondary hemorrhage from the seat of ligature presents nothing peculiar, and has already been discussed at p. 171.

2d. The *continuance or return of pulsation in an aneurismal sac* after the ligation of the artery leading to it, is an interesting phenomenon, and one that deserves some attention. When the Hunterian operation is successfully performed, though the pulsation in the sac be entirely arrested, a certain quantity of blood continues to be conveyed into and through it by the anastomosing channels, and it is from this that is deposited the laminated fibrine by which the consolidation of the tumor is ultimatly effected. This stream of blood furnished by regurgitation, or by transmission through the smaller collateral channels, is continuous, and not pulsatory; occasionally however it is transmitted in sufficient quantity by some more than usually direct and open anastomosing, or feeding branch, and thus gives rise to a continuance, or a return of the pulsation. It is interesting to observe that in some of the cases in which this has happened, there has been a return of the bruit, but that in the majority no sound appears to have been emitted.

The period of the return of the pulsation in the sac after the ligature of the artery varies greatly. In by far the majority of cases, at least two-thirds of those in which it has happened, a certain degree of thrill or of indistinct pulsation has been found in the sac shortly after the application of the ligature; at all events within the first twenty-four hours. This may be looked upon as being rather a favorable sign than otherwise, as it is indicative of a free state of the collateral circulation, and generally soon disappears spontaneously, the sac undergoing consolidation. Next in order of frequency are those cases in

which the pulsation returns in about a month or six weeks after the ligature of the artery, when the collateral circulation has been fully established, and, after continuing for some length of time, gradually ceases. It more rarely happens that the pulsation returns between these two periods; that is to say, about ten days or a fortnight after the application of the ligature, though in some instances the slight vibratory thrill scarcely amounting to a pulsation, which perhaps is perceptible a few hours after an artery has been tied, gradually strengthens at the end of a week or ten days into as distinct and forcible a beat as had been noticed before the operation. In some rare instances the pulsation has re-appeared after the lapse of some months, the aneurismal tumor having in the meanwhile undergone absorption, when indeed it may with justice be looked upon as constituting a *secondary aneurism*, and as indicating a recurrence of the complaint.

The cause of the continuance, or of the return of the pulsation in an aneurismal sac, must be looked for in too great a freedom of the collateral circulation. Indeed, I consider it an essential requisite for the manifestation of this phenomenon that there should be so free and direct a communication between the artery on the proximal side of the ligature, and that portion of the vessel situated between the ligature and the sac, or with the sac itself, as to enable the impulse of the heart to be transmitted in a pulsatory manner into the tumor. No regurgitant blood coming upwards from that portion of the artery which is distal to the sac, however free it may be, can communicate an impulse, as it never flows *per saltum* except in the special case of a continuous circle of large anastomoses such as are met with between the carotid arteries within the skull, or in the palmar and plantar arches. If any of the direct collateral or feeding vessels happen to be sufficiently large at the time of the operation to transmit the wave of blood, the pulsation in the sac will be continuous, or will return almost immediately after the application of the ligature. If they be not of sufficient magnitude for this, they may become enlarged as part of the anastomosing circulation, and then the pulsation will return so soon as their calibre is sufficient to transmit a pulsation. Besides these conditions existing in the size and distribution of the vessels of the part, it is not improbable, as has been supposed by Porter, that certain states of the blood in some individuals may, from causes with which we are unacquainted, render it less liable to coagulate than usual, and thus dispose to a return of the pulsation in the sac, which remains filled with fluid blood.

The phenomenon under consideration has been noticed in all parts of the body after the performance of the Hunterian operation, though it occurs with different degrees of frequency after the ligature of different arteries, and is certainly of more common occurrence after operations for carotid aneurism than for any other form of the disease. Thus, of 31 cases in which the carotid artery has been tied for aneurism, I find that pulsation in the tumor continued or returned in 9 instances; whereas of 92 cases of inguinal aneurism, in which the external iliac artery was ligatured, the pulsation only recurred in 6 cases; and in several of these it is interesting to note that there were two aneurismal sacs in the same limb — one in the groin, the other in the ham; and the pulsation, though permanently arrested in the popliteal, recurred in the inguinal aneurism. In the ham and axilla, pulsation occasionally though very rarely recurs. The cause of this difference in the frequency of the recurrence of pulsation in different aneurisms, is evidently owing to the different degrees of freedom of communication that exist between the sac and collateral branches in various forms of the disease; thus, in a carotid aneurism, the impulse of the heart may at once be brought to bear upon the contents of the sac, through the medium of the circle of Willis. But in the case of inguinal, femoral, or popliteal aneurisms, the anastomoses, consisting rather of the inosculations of terminal branches than of open communications between large trunks, are less

liable to transmit the blood in a pulsatory stream. For the same reason, viz., the great freedom of the communication between the vessels of opposite sides, the pulsation has more frequently been found to continue uninterruptedly and distinctly, though reduced in force, after the ligature of the artery in carotid aneurisms than in those in any other situation. The cases in which it returns after the cessation of a few hours only are perhaps as frequent in the groin and ham, as in the neck. In those instances in which the pulsation returns within the first twenty-four hours after the ligature, it usually ceases again in a few days, though it sometimes continues a week or two. When it recurs at a later period it is apt to last somewhat longer.

The prognosis of these cases is on the whole favorable, but few of them having eventually proved fatal. Of 26 patients in whom pulsation recurred, I find that 3 died, and in all of these the fatal result was occasioned by inflammation and sloughing of the sac. In all of the 3 instances the pulsation recurred within the first twenty-four hours. When it returns at a more advanced period, there is little risk to the patient, as it is usually readily amenable to proper treatment.

A *secondary aneurism* is of extremely rare occurrence; indeed I believe there are only two unequivocal instances of this affection upon record, both of which took place in the ham; the original tumor having disappeared entirely after operation, the secondary disease made its appearance after a lapse of six months, in one case, and in the other, after four years. It is of importance to distinguish between a secondary aneurism and secondary or recurrent pulsation in an aneurismal sac. The term "*secondary aneurism*" should be restricted to those cases only in which an aneurismal tumor appears in the site of a former one which has undergone consolidation and absorption, after operation. The question may be raised as to whether aneurisms of this kind are in reality secondary, or whether they may not originate in a portion of the artery contiguous to the seat of the former disease having becoming dilated. It is certainly not very easy to understand how an aneurismal sac that has once undergone consolidation and absorption, can again become dilated into a pulsating tumor; and I think it most probable, although the consecutive aneurism may be found in the same surgical region as the primary one, that it in reality takes its origin from a slightly higher part of the artery, where the same structural changes may have been in progress that determined to the disease in the first instance, at a lower point. This kind of double aneurism is indeed occasionally met with in the ham as a primary disease. I have seen a case in which an aneurismal tumor was situated in the ham, and another at, or immediately above, the aperture in the adductor muscle; if the artery in such a case as this had been tied, before the second tumor had attained any magnitude, we can easily understand how, when this became dilated, it might have been considered to have been a new enlargement of the old sac, whereas, in reality, it was nothing more than a new aneurism forming in the close vicinity of the old one.

The enlargement of an aneurismal sac, *without pulsation*, after the ligature of the artery leading to it, is an interesting phenomenon, and one that might cause the true nature of the tumor to be misunderstood, as it closely resembles in its slow and gradual increase the growth of a malignant tumor. It is occasioned by the distension of the sac, by the dark regurgitant blood brought into it through the distal end of the vessel, without sufficient force to cause pulsation, though with sufficient pressure to occasion a gradual increase in the size of the swelling.

Treatment of recurrent pulsation. — In by far the greater majority of cases of secondary pulsation, this phenomenon ceases of itself in the course of a few days or weeks by the consolidation of the sac, in the same way as after ligature of the artery, from the deposit of lamellated fibrine. This tendency to consoli-

dation of the tumor may be much assisted by means calculated to lessen the force of the impulse of the blood into the sac, such as rest, the elevated position, and the cautious application of cold to the part; cold, however, must be carefully applied, lest, as the vitality of the limb is diminished, gangrene be induced. At the same time, direct pressure may be exercised upon the sac, so as to moderate the flow of blood into it; this has in many cases succeeded in procuring consolidation of the tumor, and may most conveniently be applied by means of a compress and narrow roller. This plan is especially adapted to the popliteal and inguinal aneurisms, but cannot so well be exercised upon those situated in the neck. Care must be taken that the pressure be not at first too powerful, lest gangrene result; the object here is not so much to force out the contents of the tumor or to efface this, but simply to restrain and moderate somewhat the flow of blood into it.

In the event of the pulsation not disappearing under the influence of pressure, conjoined with rest, dietetic means, and the local application of cold, we must either perform the old operation of opening the sac, or amputate the limb. Of these measures, I should certainly advise amputation, as offering the most favorable chance to the patient. The operation of opening the sac, turning out its contents, and ligaturing the vessel supplying it, is, under any circumstances, a procedure fraught with the greatest danger to the patient, and full of difficulty to the surgeon, even when he knows in what situation to seek the feeding vessel. How much greater then must the difficulty be when he is in uncertainty as to the point at which the artery enters the sac, and cannot know whether there is more than one of these branches. In the event, therefore, of all other means failing, and of the pulsation in the tumor continuing, amputation is the only resource left to the surgeon.

3d. *Suppuration and sloughing of the sac.*—When, after the ligature of its supplying artery, an aneurism is about to suppurate, instead of diminishing in size, it increases, with heat, pain, pulsation, and some inflammatory discoloration of the skin covering it. This gradually becomes thinned, and at last gives way; the contents of the tumor, softened and broken down by the inflammatory action and the admixture of pus, are discharged through the aperture in its wall, in the form of a dark purplish-brown or plum-colored and often fetid fluid, intermixed with masses of soft dark coagula, or of the drier laminated fibrine, which may not inaptly be compared in appearance to portions of raisins or dates. The escape of these matters, variously altered, may be accompanied or followed by the escape of florid arterial blood. This hemorrhage, which is the great source of danger in the suppuration of an aneurismal sac, may occur in a sudden or violent gush at the time of the rupture of the tumor, by which the patient may at once be destroyed; or it may continue in small quantities, which, after ceasing, recur from time to time, thus gradually exhausting the patient. It is this occurrence of secondary hemorrhage that constitutes the principal danger after suppuration of an aneurism, which otherwise is not a source of any very serious risk to the patient; about one-fourth only of the cases in which the sac has suppurated having had a fatal termination, and almost all those in which death resulted, having proved fatal by hemorrhage. The patient in the few remaining instances has been carried off by some special accident, such as the pressure of the sac on the pharynx or œsophagus, or its finding its way from the axilla into the pleura or bronchial tubes. Those cases are more liable to be followed by hemorrhage in which the suppuration occurs a few weeks after the ligature of the artery, than when a longer interval has elapsed. That hemorrhage does not happen more frequently after suppuration of the sac, is very remarkable, and must be owing to the mouth of the aneurism, where it communicates with the interior of the artery, either being sealed by adhesion or plugged by coagulum. It is owing to this plugging also that in many cases the fatal bleeding does not occur at the moment of rupture, but not until a lapse of some

days, or even weeks, and then most usually under the influence of some incautious movement of the patient, by which the coagulum or adhesion is suddenly disturbed. Those cases are most dangerous in which pulsation has returned in the sac after the ligature of the vessel, but before the supervention of suppuration, as in these the tumor is so freely supplied with blood that, if it burst, fatal hemorrhage will with certainty supervene.

This accident is much more frequent in some situations than in others, and is more liable to occur in aneurisms of the axilla or groin, than in those of the ham or of the neck. The cause of the greater frequency of suppuration in axillary and inguinal aneurisms, is owing to the large size that these tumors rapidly attain, in consequence of the laxity of their cellular connections, and the difficulty of their removal by the absorbents of the part. This accident is also greatly predisposed to, by the blood contained within the aneurismal tumor undergoing simple coagulation instead of fibrinous consolidation. The mass of coagulum, instead of being absorbed, and thus gradually disposed of, as happens in a properly stratified aneurismal sac, is very apt to break up, and undergo decomposition, being converted into an unhealthy grumous fluid, that excites inflammation in the parts with which it is in contact. This state of things is especially liable to happen in those aneurisms that are of very large size, with thin parietes, and that contain previous to the operation much fluid blood and comparatively little lamellated fibrine. In other cases again it would appear that this, though properly deposited, acts as a foreign body, and gives rise to inflammation and suppurative action in the wall of the sac and the surrounding cellular tissue. Besides this, it has been very justly remarked by Mr. Porter, that the excessive handling and frequent examination to which an aneurismal tumor occurring in a hospital patient is usually subjected, may induce inflammatory action and give rise to suppuration in it.

The period at which suppuration of the sac may occur after the ligature, varies from a few days to as many months. In the majority of instances it would appear to take place between the third and eighth week; later than this it seldom happens, though it may do so after the lapse of several months, as in a case recorded by Sir A. Cooper, in which a carotid aneurism suppurated at the eighth month.

Treatment.—When an aneurism is suppurating, and is on the point of giving way, it will be better to make an incision into it, so as to let out at once the broken down and semi-putrefied contents. Its cavity must then be dressed like an ordinary abscess, with a view to its filling up by granulation, which, however, will necessarily be a slow process, in consequence of the great size and depth of the opening. During the whole of this time a tourniquet should be kept loosely applied upon the artery above the sac, so as to be tightened at any moment that bleeding takes place. If hemorrhage have already supervened, the case is attended with immediate danger. In such a case as this, the first indication is clearly to arrest the immediate flow of blood, so as to prevent the patient dying at once. This can best be accomplished by turning out the coagula and plugging the sac with lint or compressed sponge, retained *in situ* by a firm, graduated compress, and well-applied roller. The hemorrhage having thus been arrested for a time, the surgeon should take into consideration what steps should be adopted permanently to restrain it. In some cases, indeed, though these are exceptional, the plug and compress may be sufficient to prevent a recurrence of the bleeding; but in general it will not do to trust to these means unless the anatomical relations of the part be such as to preclude the possibility of adopting any more active measures.

Various plans present themselves to the surgeon for the permanent suppression of the bleeding. The sac may be laid open, and an attempt made to ligature that portion of the artery from which the blood issues. But this can scarcely be expected to succeed, as in the majority of the cases there would be

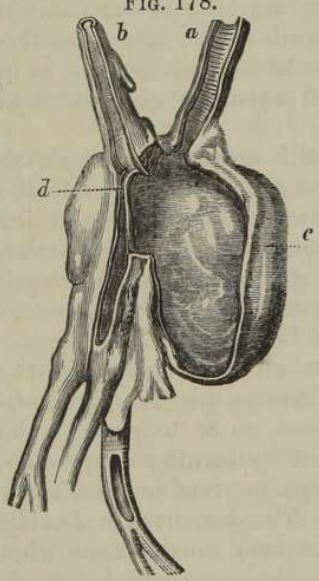
little prospect of the vessel being found in such a state as to admit of its holding a ligature, its coats being softened and pulpy, even if it were possible to expose it before the patient perished of hemorrhage. Indeed, though this plan has been several times tried, I am not aware that by it the surgeon has ever succeeded in arresting the bleeding from a suppurating aneurismal sac.

The application of the actual cautery to the bleeding orifice would, I think, hold out a better chance, more particularly if the blood were poured out from a collateral vessel of a small size. In this way, Morrison, of Monte Video, succeeded in arresting the bleeding of an aneurism in the groin that had suppurated. Should these means, however, not suffice, and they are the only ones that can be employed in many situations, as in the groin and axilla, there is no course left but, in those situations in which it can be done, either to ligature the artery higher up or to amputate. The application of a ligature nearer the centre of the circulation, even though practicable, appears to me to be of very doubtful utility, for the probability is, that the circulation through the limb, embarrassed as it must have been by the first ligature, and by the subsequent distension and suppuration of the sac, will be so much interfered with when the artery is tied a second time, that gangrene will result; or else if the collateral circulation be sufficiently active to maintain the vitality of the limb, that it will also keep up the hemorrhage from the opening in the artery communicating with the sac. Under these circumstances, the only course left to the surgeon is amputation of the limb, when the aneurism is so situated that it can in this way be removed.

4th. *Gangrene of the limb.* — The general subject of gangrene of the limb, following the injury and ligature of the main artery, has already been described (p. 174), and we have, at present, only to consider those cases in which it occurs after the operation for aneurism.

If the aneurismal sac have attained a large size with great rapidity, it may, by its pressure on the anastomosing vessels, or on the veins in its vicinity (fig. 178), produce such an amount of disturbance in the circulation of the limb, preventing the influx of arterial, or obstructing the efflux of venous blood, as to occasion a great liability to the occurrence of gangrene. But perhaps the principal source of danger consists in the aneurism becoming suddenly and widely diffused, more particularly in those cases in which the anatomical relation of the anastomosing vessels is such, as in the ham, that they may readily and uniformly become compressed by the effused blood. In these cases, the additional embarrassment induced in the circulation of the limb by the ligature of its main artery will readily induce gangrene, and hence it is that in diffused aneurism of the lower extremity, the ligature of the artery is so commonly followed by mortification.

FIG. 178.



Inguinal aneurism compressing the veins, and thus causing gangrene of the limb; *a*, artery; *b*, vein, compressed at *d*; *c*, aneurism.

The loss of blood, either in consequence of secondary hemorrhage, or in any other way, before or after the application of the ligature, is very apt to be followed by gangrene; the more so if the state of things has rendered it necessary to apply a ligature to a higher point on the trunk of the vessel than had previously been done. This secondary ligature of a large artery, in cases of aneurism, has, I believe, been invariably followed by gangrene of the limb when done in the lower extremity, the interference with the collateral circulation by the second ligature being so great, that the vitality of the part cannot be maintained.

Besides these causes, the occurrence of erysipelas, exposure of the limb to cold, or to an undue degree of heat, or subjecting it to the compression of a bandage, may be attended by consequences fatal to its vitality.

The period of the supervention of gangrene of the limb, is usually from the third to the tenth day; it seldom occurs before this period, unless incipient mortification have already set in before the artery is tied. Gangrene usually follows the ligature of the external iliac at an earlier period than that of any other artery. In cases of aneurism, the gangrene is always of the dark and moist variety, owing to its being commonly dependent on pressure upon the large venous trunks by the aneurismal tumor.

The general preventive *treatment of gangrene* dependent on the ligature of the artery for aneurism, must be conducted on the same principles as when it arises after the ligature of arteries generally. But some special modifications of it are required so far as the aneurism is concerned. When the gangrene occurs from the pressure of the sac upon the accompanying vein, it has been proposed to lay the tumor open, and to turn out its contents, thus removing the compression exercised by it. The danger of such a proceeding consists in the probability of the occurrence of hemorrhage from the opening made into the sac, and from the risk attending suppuration set up in this; but yet, it would appear that in two cases in which this practice has been adopted, no bad results followed. Thus, Lawrence has related a case of diffused aneurism of the popliteal artery in which this plan was had recourse to with the best results, and Mr. Benza ("Medical and Physical Journal," vol. lv.) has recorded a case of popliteal aneurism in which the same practice was adopted, in consequence of great œdema and incipient gangrene of the foot; when after the extraction of a quantity of flesh-like fibrine from the sac, the patient made an excellent recovery. These cases would certainly justify the surgeon in adopting such a course when the danger of gangrene is imminent, and dependent on the size and pressure of the tumor. Should, however, the gangrene show any disposition to extend, or should there be hemorrhage from the sac after it has thus been laid open, the surgeon must hold himself in readiness to amputate without delay. When gangrene has once fairly set in, there is no reasonable prospect of saving the limb, and the sooner amputation is done the better. The limb must always be removed high up above the sac, and, if possible, not only at some distance from the parts that have mortified, but above the limb to which the serous infiltration that precedes this condition has extended. The upper extremity must generally be removed at the shoulder-joint, the lower, above the middle of the thigh. In these cases there will generally be a considerable amount of hemorrhage, and many vessels to tie in the stump, in consequence of the enlargement of the collateral circulation.

THE TREATMENT OF ANEURISM BY COMPRESSION.

In consequence of the dangers and difficulties attendant upon the use of the ligature, surgeons have for many years past endeavored to treat aneurism by compression. The employment of direct pressure on the aneurism was almost naturally suggested as a means to counteract the extension of the disease by the pressure of the blood from within, and has consequently been applied from a very early period in the treatment of the affection. This plan of treatment was first employed by Bourdelot at the close of the seventeenth century; afterwards by Genga, Heister, Guattani, and others. These surgeons made the pressure directly upon the sac; and Guattani and Flajani relate several cures that they effected in this way; but the method was so uncertain in its results, and so dangerous from irritating and inflaming the sac, that it fell into disuse. The French surgeons introduced a modification of the pressure plan by laying open the sac, clearing out its contents, and applying the pressure directly over the

ends of the vessel. Deschamps exposed the artery leading to the sac, and compressed this with an instrument he termed the "presse artère." These barbarous modes of treatment, however, were entirely set aside by the facility and comparative success of the Hunterian operation, and compression in aneurism was rarely practised by surgeons after the great step made by John Hunter in the treatment of this disease. Yet we find that John Hunter himself, Blizard, and Freen attempted, though with but little success, to cure this disease by pressure on the artery leading to the sac. Pelletan and Dubois appear to have been the first who employed the pressure upon the artery above the sac, instead of upon the aneurism itself; this was in 1810. Since this period various attempts were made methodically to treat aneurisms in this way; but the merit of having introduced the practice of compression in the treatment of aneurism into modern surgery, of having given it a definite place in our art, and of having established the true principles on which it acts, incontestably belongs to the Dublin surgeons; amongst whom the names of Hutton, Bellingham, Tufnell, and Carte deserve especial mention. In the early trials of the cure of aneurism by compressing the artery on the cardiac side of the tumor, the surgeons who employed this method acted on an erroneous theory, and the principle not being understood, the practice was bad. It was supposed that it was necessary for the cure to take place that the *whole* flow of blood through the artery should be entirely arrested, that inflammation of the vessel at the point compressed should be set up, and that the consolidation of the aneurism depended upon the obstruction of the vessel consequent upon this inflammation. This led to compression being exercised so forcibly, with the view of exciting inflammation in the artery, that the patient could seldom bear it for a sufficient length of time to effect a cure, sloughing of the skin commonly resulting as a necessary consequence of the severe pressure to which it was subjected. To the Dublin surgeons belongs the very great merit not only of having pointed out the error of this doctrine, but of having distinctly laid down as the principle of the practice, that the aneurism was cured, when the artery leading to it was compressed, in precisely the same way as when a spontaneous cure takes place, or when the Hunterian operation is performed — viz., by the deposit of stratified fibrine in the sac, and by the consequent consolidation of this (fig. 179), aided by the contraction of the walls of the sac; and that, as in the case of the ligature of the vessel, it was not necessary for the whole of the circulation through the artery to be entirely and permanently arrested, but merely for it to be lessened in quantity and force to such an extent as to be compatible with the formation of laminated fibrine in the sac; and it was clearly shown by examination after death that if the pressure were properly conducted, the artery was in no way injured or occluded at the part compressed. This recognition of the true principles on which compression of the artery leading to the sac cures the aneurism, has led to important results; for, as the severe pressure that was formerly considered necessary is now known not only to be useless, but to be absolutely injurious, no amount of compression is exercised beyond what is requisite to restrain and moderate the flow of blood into the sac; no attempt being ever made to compress the artery so severely as to lead to its obliteration by inflammation.

Fig. 179.

Though I have stated generally that aneurisms, when treated by compression, are cured by the deposit of laminated fibrine, I think this remark ought to be confined to the common sacculated form of the disease. In the tubular variety, which is certainly of far less frequent occurrence in the extremities, the cure of the aneurism takes place by contraction of the sac, and by its

becoming filled by fibrine in a somewhat irregular manner. Illustrative of this mode of cure, there is a preparation in the Museum of University College (fig. 180).

Fig. 180.

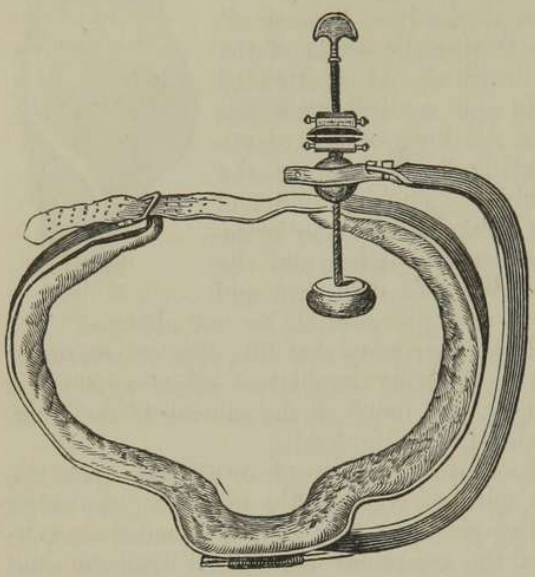
The success of the treatment by compression depends greatly upon a scrupulous attention to a number of minor circumstances, which, though trivial in themselves, become of importance when taken as a whole. During the whole of the treatment, also, the patient's general health should be attended to in accordance with those dietetic and medical principles that have already been laid down in speaking of the constitutional treatment of the disease, having for their object, the increase of the fibrination of the blood. The irritability of the heart and arteries must also be subdued, and the irritation of the system lessened, by the use of opiates, and the patient should be put into a comfortable bed, with firm and well-secured pillows and mattresses, so that his position be not changed. As it is principally in aneurism of the lower extremity that this plan of treatment can be employed, we shall proceed to describe the method of its application here; and, in doing so, I would remark, that much of the success of the treatment depends on a scrupulous attention to minute details.

The limb having been bandaged smoothly, with a soft or air pad upon the tumor, so as to approximate its sides, and laid comfortably on pillows, the thigh should be shaved, and dusted with hair-powder. The apparatus must next be applied, and much of the success of the treatment will depend upon the kind of instrument used. The ordinary horse-shoe, or Signorini's tourniquet, was the one first employed, and this will, in many cases, answer the purpose perfectly well; but as it is somewhat difficult to regulate the pressure with this instrument, and as it is not unfrequently exercised too powerfully, it has generally given place, at the present day, to the very ingenious apparatus of Dr. Carte, which, as it substitutes an elastic force derived from vulcanized India-rubber bands for the unyielding pressure of the screw, accommodates itself better to the limb, and is less likely to produce injurious compression. This instrument, as well as the other contrivances which have at various times been invented for the treatment of aneurism by compression, are described by Drs. Bellingham and Tufnell, in their works on this subject, to which I must refer for a fuller account than I can here give. In some cases the circulation through the artery may conveniently be controlled by the pressure of a weight laid over it in the groin as it passes over the pubes; usually from a four to a seven pound weight is sufficient for this purpose. In this way, when only one compressor is applied on the limb, the flow of blood may be checked during the time that the screw is loosened. Care must of course be taken that the weight do not slip off. It is best made of lead, cast in a conical shape, and may be retained *in situ* by having a wide leather socket made to fit it, shaped somewhat like the hopper of a mill; its broad end should be upwards, and the narrow end press on the vessel.

In applying the compressor, especial care must be taken that it is well padded in every part, so as not to gall the skin. In some of the early cases in which I saw compression employed in London by means of the horse-shoe tourniquet, much inconvenience resulted from want of attention to this particular. The tendency to fretting of the skin is much lessened by powdering the limb, and the removal of the cuticular hairs by shaving diminishes materially the irritation produced by the instrument. In order to keep up continuous pressure, and at the same time to prevent any one part of the skin being injuriously galled, it is of very great consequence that two instruments should be used at the same time, so that when one is screwed up the other should be loose; these instruments need not be placed closely together. If the

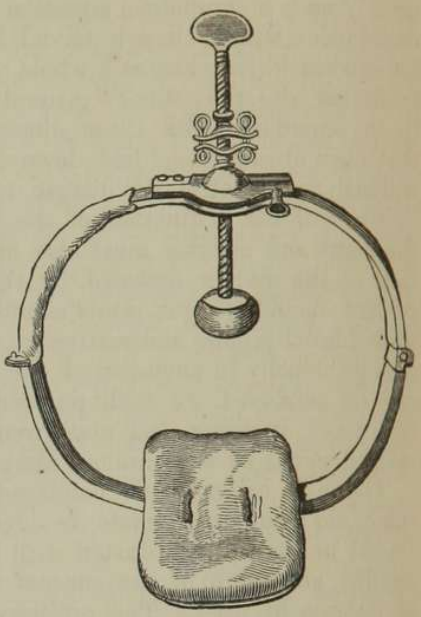
aneurism be in the ham, it will be sufficient for one (fig. 181) to be applied to the groin, whilst the other (fig. 182) is put upon the middle of the thigh. In

Fig. 181.



Compressor for the groin.

Fig. 182.



Compressor for the middle of the thigh.

using the instrument, the great point, as Dr. Tufnell most properly remarks, is to control the circulation with the minimum of pressure; in order to do this the first instrument should be screwed up so that all pulsation ceases in the tumor, but still not so tightly as to arrest all the flow of blood through it. As the pressure exercised by this becomes painful, it must be slightly loosened, and the second one screwed up. In this way an alternation of pressure can be kept up without much pain or inconvenience. If possible the patient should be taught how to manage the instrument himself, and will often find an occupation and amusement in doing so. If however it excite much pain or irritation, as it does in some subjects, it may be necessary to give opiates. The pressure should, if possible, be continued during sleep, but if it prevent the patient taking his natural rest, the suggestion made by Dr. Tufnell, of unscrewing the instrument slightly, and, when the patient is asleep, gently tightening it again without awakening him, may advantageously be adopted; it is indeed surprising how very little unscrewing will relieve the pain of the compression. A large cradle should then be placed over the patient's body, so that the weight of the bed-clothes may be taken off the apparatus, and that the patient may manage it without risk of disturbance. Should there still be much uneasiness, the instrument might be taken off for a few hours, and compression kept up in an intermittent manner. Even under such circumstances as these consolidation of the sac may ensue.

The effects upon the tumor vary considerably. In some cases it rapidly and suddenly solidifies; more commonly, however, this is a gradual process, the aneurism becoming more painful and solid, with less pulsation and bruit. As the solidification takes place, there is usually a good deal of restlessness, a feeling of general uneasiness, and of constitutional disturbance, which is best quieted by opiates. As the pressure is continued, and the tumor begins to harden, the anastomosing vessels enlarge, with a good deal of burning pain in the limb generally, and arterial pulsations in situations where usually none are

felt. The abnormal pulsation, in these cases, is always found to occur in much the same situations, the same vessels appearing to undergo dilatation. Thus Tufnell has made a remark, which I have had more than one opportunity of verifying, that in the treatment of popliteal aneurism by compression, three arteries will be found to be enlarged, one of which passes over the centre of the tumor, another over the head of the fibula, and the third along the inner edge of the patella; he also states that the severe burning pain which is felt in these cases, is owing to the artery accompanying the communicans peronei nerve being enlarged. After complete solidification of the tumor has taken place, the compression ought to be continued for at least forty-eight hours, so as to secure against the occurrence of a relapse.

The duration of the treatment varies very greatly. In some cases the tumor has become solidified in a few hours or days. In other instances again the treatment must be protracted for more than three months before a cure results. Of 26 cases of femoral or popliteal aneurism cured by compression in the London hospitals, the average time, according to Mr. Hutchinson, was nineteen days. Much of course will depend, in this respect, on the constitution of the patient, and on the condition of the tumor; those circumstances which are most favorable to the spontaneous cure of the aneurism will also influence the rapidity of the cure by compression.

Of the great value of compression in the treatment of aneurism there can be no doubt; but yet it cannot be looked upon as taking the place of the ligature in the cure of this disease, except in those cases in which the tumor is situated in the arteries of the lower extremity, below the middle of the thigh. In aneurisms occurring in the vicinity of the trunk, as in the iliac, the carotid, subclavian, and axillary arteries, it is quite inapplicable. Spontaneous aneurism being extremely rare in the upper extremity, and as the traumatic forms of the disease which occur here, generally require that the sac should be laid open, it is seldom found necessary to have recourse to it in this part of the body, though it may be and has been successfully applied to the brachial artery.

The great question with regard to compression appears to me, after all, to be whether it possesses any special advantages over the ligature, in the treatment of femoral and popliteal aneurisms, to which its employment is necessarily chiefly confined. The principal objections that have been urged against compression are that its employment is more painful and tedious than the use of the ligature, and that those cases that are unpromising to the ligature or that require amputation rather than it, are equally unfavorable to compression, and cannot be saved by the employment of this means.

To these objections I think it may with justice be answered, that the pain attendant on the employment of compression depends very greatly upon the skill and care with which the apparatus is applied and managed throughout, and that much depends upon the kind of instrument that is used, being certainly much diminished when Carte's elastic instrument is employed. With regard to the relative tediousness of the treatment under the two plans, it would appear that in reality there is but little difference; for although some cases in which compression is used, are prolonged over a considerable space of time, yet they do not occupy more than is often consumed when accidents of various kinds follow the use of the ligature; and it not unfrequently happens in compression, what can never occur after the employment of the ligature, that the patient is cured of his disease in a few hours or days. Taking, however, the average of the Dublin cases, we shall find that the treatment lasted twenty-five days, and in the recent London cases but nineteen, and this is not very different from what happens with the ligature; for of 54 cases recorded by Crisp, in which the femoral artery was tied, the average time for the separation of the ligature was eighteen days, and if to this a week more be added for the closure of the

wound, and for the treatment of the various accidents so often accompanying and following the ligature, we should probably be within the mark, and yet only bring the duration of the treatment of the two methods to the same level.

After all, surgeons will eventually be guided in their estimate of the value of the two plans of treatment, not so much by the question of submitting their patients to a slightly more painful or tedious treatment, as to the comparative risk of life attendant upon one or other method. Upon this point the statistics have yet to be made; partly because the cases of the treatment of aneurism by compression have not as yet been very numerous, and partly because the unsuccessful cases of ligature have not been so commonly published as the successful ones. If, however, we compare the 32 cases of femoral and popliteal aneurism treated in Dublin up to February, 1851, as given by Dr. Bellingham (Med Chirurg. Transactions, vol. 34) with the results of the 188 cases of femoral and popliteal aneurism, recorded by Norris, in which the artery was ligatured, we shall find that of the 32 compression-cases 26 were cured; in 1, the ligature was applied after pressure had failed; in 2, amputation was performed; in 1, death occurred from erysipelas; in 1, from chest disease; and in 1 case the pressure was discontinued. Thus it would appear that 6 out of the 32 failed, being in the proportion of 1 to 5·3 cases, and 2 died, being in the ratio of 1 to 16. Of the 188 cases in which the artery was ligatured, 142 were cured, 46 died, 6 were amputated, in 10 the sac suppurated, and in 2 gangrene of the foot occurred. Thus the deaths after ligature were in the proportion of 1 to 4, and the failures or serious accidents, of 1 to 3, showing clearly a very considerable preponderance in favor of the treatment by compression. Besides which, in many patients who recovered after the ligature, various accidents, such as gangrene, erysipelas, secondary hemorrhage, &c., resulted as the direct consequences of the treatment, and these do not happen when pressure is employed.

If the compression fails, the ligature may then often be advantageously applied; and as has been shown by the known cases, with a better success than if compression had not previously been tried, that treatment having caused the collateral circulation to enlarge, and thus lessened the tendency to gangrene.

It should also not be forgotten that in some cases, such as when aneurism is complicated with heart disease, or occurs in a very broken and unhealthy constitution, in which the operation necessary for the application of the ligature would scarcely, or not at all, be admissible, compression may be safely employed.

After carefully considering the relative merits of the two plans of treatment, I think we may conclude that, though in some few cases neither method can be adopted, and amputation is the sole resource, yet, that in others compression can be employed when it would not be safe to have recourse to the use of the ligature; and that in all ordinary cases of femoral and popliteal aneurism especially, compression should be preferred to the ligature, inasmuch as it is not a more tedious, and an infinitely safer method of cure. At the same time it must not be forgotten that its success depends very greatly on the continuous care bestowed upon the case during the progress of the treatment.

MANIPULATION, GALVANO-PUNCTURE, ETC.

Mr. Fergusson has proposed to treat some aneurisms by a procedure which he terms "manipulation." This consists in squeezing the aneurismal tumor in such a way as to detach a portion of the coagulum within it, which, being carried on with the current of blood into the distal end of the artery, obstructs this; and thus, by impeding the circulation through the sac, may lead to the gradual consolidation of the tumor. This procedure has as yet been employed to too limited an extent to enable us to form an estimate of its value, and can scarcely be considered, nor is it intended to be of very general application. To such aneurisms, however, that are not amenable to ordinary surgical treatment

as those situated at the root of the neck, more particularly of the subclavian artery, it might possibly be advantageously applied. It is scarcely necessary, however, to point out the obvious danger of rupture of the sac, or of the diffusion of the aneurism on the separation of the coagulum, to make surgeons adopt due caution in carrying out this method of treatment.

The attempt to procure consolidation of an aneurismal sac by the employment of electricity or galvanism is of comparatively recent date. It appears to have been first practised by Mr. B. Phillips, about the year 1832. Little attention, however, was given to this mode of treatment until a few years back, when it was revived by some of the French and Italian surgeons, especially by Petrequin and Burci. The principle on which this operation is conducted consists in endeavoring to produce coagulation in the aneurismal sac, by decomposing the blood contained in it, by means of the galvanic current. In some instances, the attempt to do this has induced, and, in all, it must occasion the liability to inflammation of the sac and of the surrounding structures; as the change that is sought to be effected in the contained blood, consists not in the deposit of its fibrine, but in the coagulation of it *en masse*. It has of late been recommended to conjoin the employment of compression of the artery, either above or below the sac, with the transmission of the galvanic current through it, there being in this way less liability for the coagulum that is deposited to be broken down and washed away, as would happen if the current of blood were allowed to pass through the sac whilst it is in the act of forming.

The coagulation of the blood is effected by introducing two acupuncture needles into the sac in opposite directions, and keeping them in contact with one another, after connecting them with a galvanic battery of moderate tension, when coagulum becomes deposited around one of the needles. The operation should be continued for periods varying from ten minutes to a quarter of an hour, and requires to be repeated several times. Petrequin recommends that the direction of the current be changed from time to time, so that a number of clots may be formed in the sac. In this way a soft mass of coagulum may occasionally be formed in the tumor, so as to fill it up more or less completely, and to prevent the passage of blood through it. Occasionally it happens, however, that the blood has continued fluid, and the sac pervious, no coagulation having been effected; and in other instances, again, the amount of inflammation that has been set up in the sac has been so great as to give rise to its sloughing, to the occurrence of secondary hemorrhage from it, and to the loss of the patient's limb or life. This inflammation may, in some cases, doubtless, have been the result of the injury inflicted upon the sac by the introduction of the needles, and by the charring of the tissues by them; but, in other cases, I think it probable that it may have taken place from the rapid coagulation of the contained blood, an occurrence that we have already seen tends especially to inflammation, suppuration, and sloughing of the aneurismal sac. The pain of the operation is always very considerable, so much so, that patients who have been subjected to it once have refused to submit to a repetition of it.

Up to July, 1851, M. Bonnet had collected 23 cases of aneurism treated in this way; of these, 8 were of the brachial artery, 7 of the popliteal, 2 of the subclavian, and 1 of each of the following: the ophthalmic, the temporal, the carotid, the thoracic aorta, the ulnar, and one unknown. Of these the proceedings failed in 13 instances; 9 cases were reported as successful, but in 7 of these, M. Bonnet states that doubts must be entertained both as to the results and as to the treatment, for the cure took place not by galvano-puncture alone, but in some by the conjoined influence of compression and the application of ice; and in others, as the result of inflammation and suppuration of the sac. There are consequently only two cases in which the cure can clearly be attributable to this means alone, and without the occurrence of any serious accident.

When we compare the galvano-puncture with ligature or compression, in the

treatment of external aneurism, it is I think impossible to hesitate for a moment in giving a decided preference to the latter modes of treatment. Not only is the principle on which it is attempted to procure obliteration of the sac in galvano-puncture a vicious and peculiarly dangerous one, viz., by the coagulation of the blood, and the inflammation of the wall of the sac; but the results that have hitherto been obtained by this method, are not such as would justify a prudent surgeon in submitting his patient to experiments of this kind, when he possesses so certain and comparatively safe a mode of cure as that by deligation or compression. In *internal* aneurisms, or in those cases in which the disease is so situated at the root of the neck, that the artery can neither be ligatured with safety nor compressed, galvano-puncture may perhaps be employed with some advantage, in conjunction with proper medical treatment.

The injection of aneurismal sacs with a solution of the perchloride of iron has also of late been practised, with the view of coagulating their contents, but such treatment is not only coarse and unscientific, but dangerous; and, when compared with the ligature or compression of the artery leading to the sac, must be looked upon as a retrograde step in surgery.

SPECIAL ANEURISMS.

CHAPTER XXXVII.

ANEURISMS OF THE LOWER EXTREMITY.

ARTERIO-VENOUS ANEURISMS.

PRETERNATURAL communications between arteries and veins, though usually the result of wounds, occasionally happen from disease, ulceration taking place between the vessels, and thus causing an aperture to lead from one into the other. When such communications are of a traumatic character, they may, as has already been stated, either constitute an aneurismal varix or a varicose aneurism. As the result of disease, aneurismal varix only can occur, varicose aneurism never happening except as a consequence of wound. These spontaneous communications have been met with between the aorta and the vena cava, and between the iliac, femoral, carotid, and subclavian arteries, and their accompanying veins. In nature, symptoms, course, and treatment, they so closely resemble traumatic aneurismal varix, described at page 168, that their consideration need not detain us here.

INGUINAL ANEURISMS.

An iliac or inguinal aneurism may arise from the external iliac or from the common femoral artery; most frequently it springs from the latter, and taking a direction upwards pushes the peritoneum before it, and thus encroaches some what upon the cavity of the abdomen. When first noticed it is a small, soft, compressible tumor, with pulsation and bruit, and generally attended by little pain or uneasiness. It rapidly enlarges, however, and may attain a considerable magnitude, being often somewhat lobulated upon the surface, owing to the unequal constriction exercised upon it by the fasciæ under which it lies. At

the same time it usually becomes more solid, and the pulsation in it diminishes considerably, or even ceases entirely. As it increases in size it compresses the saphena and femoral veins, thus giving rise to œdema of the limb; and by stretching the genito-crural and some of the branches of the anterior crural nerve, occasions considerable pain in the thigh and leg.

These aneurisms are commonly of the circumscribed false variety, though sometimes tubular; they never become diffused, for the reason long ago pointed out by Scarpa, that the femoral artery, above the edge of the sartorius muscle, is invested by so dense a sheath and is so closely bound down by the neighboring fascia, that when dilated into an aneurism it does not readily give way.

The *diagnosis* of inguinal aneurism is not always so easy as might at first appear. It has most frequently been confounded with abscess in the groin, carcinomatous tumors in this situation, and with osteo-aneurisma. The diagnosis from abscess must be made on general principles, but in some instances appears to be replete with difficulty, as there are not a few cases recorded, in which aneurisms in this situation have been mistaken and punctured for abscess, an error that has in every instance proved fatal. The diagnosis of an inguinal aneurism, solidified by the deposition of laminated fibrine, and pulsating but indistinctly, from a pulsating encephaloid or osseous tumor in the groin, is surrounded by the greatest difficulty, and cannot, I believe, with the means we at present possess, be accomplished with absolute certainty. The fact of the two diseases having in two instances been confounded during the last few years, by two of the most distinguished surgeons of the day, Mr. Stanley and Mr. Syme, is sufficient evidence of the difficulty attending their diagnosis.

Treatment of inguinal aneurism. — It occasionally happens that inguinal aneurisms, even of a very large size, undergo spontaneous cure, or become consolidated by direct pressure conjoined with constitutional treatment; but these instances are of such rare occurrence that such a result cannot be relied on in any one case. In the majority of instances the tumor, though it may have encroached on the abdomen, will not have reached too high for the external iliac to be ligatured; should it have done so, however, the surgeon may have to tie the common iliac artery, but in some instances even this may not be practicable, when his choice must lie between the slender chance offered by constitutional treatment and pressure, and the fearful alternative of ligaturing the aorta.

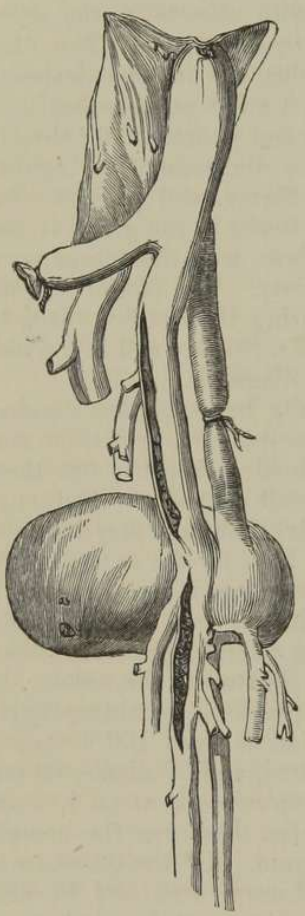
THE LIGATURE OF THE EXTERNAL ILIAC was first practised by Abernethy, in 1796. Since this period it has been had recourse to in at least 100 instances for inguinal aneurism (Norris); of these, 73 were cured, and 27 died. In one remarkable case, both external iliacs were ligatured successfully at an interval of eleven months, by Mr. Tait. In some few cases also, there was the complication of an aneurism in the ham with that in the groin. Of the 92 cases in which the aneurism was solely seated in the groin, 70 were cured, and 22 died. Death resulted from gangrene of the limb in 8, from secondary hemorrhage in 4, from sloughing of the sac in 3, from tetanus in 3, and from causes of a more general character in 4 cases.

Pulsation returned in the sac in 6 cases; in some not until several weeks had elapsed after the operation; and in 1 instance only was this phenomenon followed by death. Suppuration of the sac was of frequent occurrence, happening in 13 instances, doubtless owing to the large size that these tumors are often allowed to attain before being subjected to surgical interference. It is remarkable, however, that in 3 cases only was this accident fatal, and in 2 of these 3 instances the sac had been opened before the operation, on the supposition of its being an abscess. Secondary hemorrhage occurred but in 6 cases, 4 of which proved fatal; a very small proportion when compared with what happens in other situations. This must doubtless be attributed in a great measure to the absence of any collateral branches springing from the trunk of the external iliac, the distance between the point ligatured, and the epigastric and circumflex ilii arteries,

affording abundant space for the safe obliteration of the vessel. In 1 of the fatal cases pulsation had previously returned in the sac; in the other 3 the patients died on the seventeenth, the twenty-seventh, and the forty-third days, respectively.

Gangrene of the limb is the most common cause of death after deligation of this vessel, occurring in 9 instances, of which 8 proved fatal; 1 being cured by amputation. The period at which the mortification supervened varied from the third to the fourth week. The principal cause of this gangrene is narrowing, or obliteration of the neighboring venous trunk by pressure of the tumor. In the accompanying wood-cut (fig. 183) this is well illustrated; the vein opposite the aneurism being completely closed.

Fig. 183.



It is a very remarkable circumstance in the history of this operation that three deaths have resulted from tetanus, a most unusual occurrence after the ligature of arteries.

The ligature of the external iliac for aneurismal varix in the groin affords a striking contrast with that for spontaneous aneurism; the 4 cases recorded all proving fatal, 2 dying of gangrene, and 2 of hemorrhage. In these cases, Mr. Guthrie has recommended that the tumor should be laid open, and the artery ligatured above and below the aperture in it. But with whatever rapidity and dexterity such a proceeding were accomplished in the groin, there will be great risk of such a loss of blood ensuing as to endanger the patient's life, there being no possibility of commanding the artery above the seat of disease.

Aneurism occasionally takes place in the groin and ham of the same side; here the ligature of the external iliac will cure both diseases. Of 4 cases in which this complication occurred, the operation was successful in 3, one patient dying of gangrene, and in him the popliteal aneurism was on the point of bursting at the time of the operation. In 2 of the 3 cases that recovered, pulsation returned in the inguinal aneurism, but disappeared after a time.

Operation.—There are two modes of tying the external iliac artery; the one originally practised by Abernethy, somewhat modified by Liston, and the other introduced by Sir A. Cooper. Abernethy's method modified, consists in commencing an incision two fingers' breadths above, and somewhat to the inner side of the middle of Poupart's ligament, and carrying it upwards and outwards to the extent of about four inches, so that it terminates at about three fingers' breadths to the inner side of the anterior superior spine of the ilium. After dividing the skin and superficial fascia, the fibres of the external oblique tendon are carefully cut through. The internal oblique and the transversalis muscles are then cut through with great caution, when the transversalis fascia is reached, which is recognized by its dull white appearance. A small portion of this membrane, at the lower angle of the wound, where it is thinned and expanded for the passage of the cord, is now carefully raised with the forceps and scratched through with the point of the scalpel. A director is then introduced, and passed underneath it, when it should be laid open upwards and outwards to the full extent of the wound; the whole of the inner side of the wound is next drawn towards the mesial line, the peri-

toneum being separated from its loose cellular connections in the iliac fossa by the surgeon's fingers; it must be kept out of the way by an assistant, who holds it up with a broad bent copper spatula. The artery may now be felt pulsating at the bottom of the wound, covered by a dense fascia, and having the vein lying to its inner side, and somewhat behind it. The investing sheath must be scratched through in two situations, and the needle passed from the inner side between the vessels, the ligature being then tied in the usual way.

In Sir A. Cooper's operation, an incision about three inches in length is made a little above and nearly parallel to Poupart's ligament, beginning above the inner margin of the abdominal ring, and ending near the anterior superior spine of the ilium. By this incision the tendon of the external oblique is exposed, and must be divided to the full extent of the external wound, when the spermatic cord will be seen passing under the lower edge of the internal oblique and transversalis muscles. Some loose cellular tissue and fascia has now to be scratched through, and the finger being passed under the cord, will come in contact with the external iliac artery, close to the spot where the epigastric is given off from it; the upper side of the incision must now be well raised by a copper spatula, when the vessel will be exposed, covered by a dense sheath, and having the vein to its inner side, the sheath must be cautiously opened, and the ligature passed in either direction.

On comparing the two operations, it would appear that the principal disadvantage of Abernethy's is, that it is apt to leave a tendency to hernial protrusion, in consequence of the abdominal wall being much weakened by the free incisions through the muscular planes that are necessary; the great advantage attending it is, that the external iliac may be ligatured at any part of its course, and that, if requisite, the incision might be even extended upwards, and the common trunk secured. In Sir A. Cooper's operation, the line of incision lies directly across the course of the epigastric artery, which, as well as the circumflex ilii, if it arise high, and the circumflex vein, which crosses the iliac artery at this point, and is often somewhat funnel-shaped, may be in danger of being wounded. The spermatic cord is likewise somewhat in the way in this operation. Dupuytren actually wounded the epigastric artery in one case, and Houston had much difficulty from the circumflex vein in another instance. This operation has also the disadvantage, that by it, it is impossible to prolong the incision upwards so as to deligate any portion of the vessel except that which lies immediately above the crural arch; but the peritoneum is less disturbed than in the other case, and there is less tendency to hernial protrusion afterwards. As a general rule, I think we may conclude, that, in cases of spontaneous aneurism, in which it might, from the size of the tumor or the diseased state of the vessels, be found necessary to apply the ligature to a higher point than was intended before the operation commenced, it will be safer to have recourse to Abernethy's plan, modified as above described, as in this way we shall be able to ligature the vessel at any part of its course; whilst in cases of hemorrhage after amputation, or in traumatic femoral aneurism, in which the artery is not likely to be diseased, Cooper's operation should be had recourse to, more particularly if the patient be thin, and the abdomen flat.

In connection with the ligature of the external iliac artery, there are some practical points that deserve mention. Before the operation the colon should be emptied by means of an enema, and the pubes shaved. The incision in the abdominal wall must be sufficiently extensive, but should never be allowed to implicate the external ring, lest it give rise to a tendency to hernial protrusion. Care should be taken not to wound the peritoneum, for although two patients, in whom this was done by Post and Tait, both recovered, yet it is of course a dangerous accident, and should if possible be avoided. The peritoneum must not be torn up more than is absolutely necessary, lest hemorrhage or subsequent peritonitis occur, and especial care must be taken that the fascia transversalis

be properly divided, otherwise the iliac fascia may be stripped up with the peritoneum, and the artery in this way dragged out of its normal situation into the upper and inner angle of the wound, occasioning great embarrassment to the operator, who may not be able to find it. Before attempting to pass a ligature round the vessel, the dense fascia covering it must be scratched through with the point of a scalpel, and lastly the sac must not be injured by having its peritoneal covering stripped off.

Ligature of the common iliac. — If the aneurism in the groin extend so high that there is not sufficient space for the exposure and ligature of the external iliac artery, it becomes necessary to tie the common trunk. This may be done by extending the incision that serves for the ligature of the external iliac upwards and slightly inwards towards the umbilicus, to an extent corresponding to the degree of obesity of the patient, so that it assumes a somewhat semilunar form. Or a semilunar incision may be made from a point about two or three inches above the umbilicus, and carried downwards and inwards to a corresponding extent below it. The incisions are then successively carried through the different planes of muscular fibre with great caution and on a grooved director, until the transversalis fascia is exposed; they must be carefully opened and freely divided, so as to expose the peritoneum, which now comes bulging into the wound, pressing forward with its contents. This must be held aside, drawn upwards by the fingers of an assistant, and gently stripped from the iliac fossa by the surgeon carefully insinuating his hand beneath it. When he arrives at the brim of the pelvis, he will readily be conducted to the external iliac artery, which guides him to the parent trunk. The ligature must then be passed under the artery, a slight scratch having been made through the fascia covering the vessel.

In planning the incision for the ligature of this artery, care should be taken that it be not carried too low down or too far forwards; nothing can be gained by doing so, and there is besides the additional risk of the circumflex ilii or epigastric being wounded, as happened to Mott, and as these are principal agents in the anastomosing circulation, their injury is a serious accident. Should any muscular branches bleed they had better be ligatured, so as not to obscure the after-steps of the operation. The fascia transversalis should be opened at the lower part of the wound, where it is thinned for the passage of the cord, by pinching up a portion of it with the forceps, and dividing it carefully with the edge of the knife laid horizontally. It will be found to be much thicker and denser at the upper and outer part of the wound, than in this situation. When the peritoneum is well drawn upwards to the mesial line by the assistant's fingers or copper spatulæ, the ureter which crosses the artery in this situation will be carried up with it, so as not to be seen at all. In this stage of the operation, the patient should be turned on his sound side, in order to prevent the intestines falling over and pressing the peritoneum into the wound.

In determining the length of the incision, and calculating the point at which he would expect to meet with and ligature the artery, it is a matter of the very first importance for the surgeon to remember the different bearings of the parts in the neighborhood of the vessels, and the relative frequency with which the origin and termination of the artery correspond with certain fixed points that may readily be detected.

The points of importance are the relations of the vessels to the lumbar vertebræ, to the crest of the ilium and the umbilicus. The ordinary place of division of the abdominal aorta is on the body of the fourth lumbar vertebra, or on the intervertebral disk below it; according to Mr. Quain, this was the case in three-fourths of the bodies he examined, or in 156 out of 196. In regard to the relations between the situation of the bifurcation of the aorta and the crest of the ilium, we find it, according to the same anatomist, to have ranged in

about four-fifths of the cases about half an inch above and below the level of the highest point of this part of the bone. With reference to the umbilicus no definite rule can be laid down, but in general terms it may be stated that the bifurcation of the aorta is a little to its left. As a general rule that given by Hargreave is perhaps sufficiently good for ordinary purposes. If a point be taken about half or three-quarters of an inch below, and a little to the left of the umbilicus, and a line be drawn on each side from this point to the centre of Poupart's ligament, we obtain about the direction of the common and external iliac arteries. On dividing these lines into three equal parts, the upper third will correspond to the primitive trunk, and the two lower thirds to the external iliac, and the junction of the upper with the middle third to the bifurcation of the common iliac artery.

The point of division of the common iliac artery, is, in the majority of cases, between the middle of the fifth lumbar vertebra and the middle of the sacrum, both points inclusive; and if it is not in this situation the division will probably be lower down.

The length of the vessel varies greatly; according to Quain, in five-sevenths of the cases, it ranged between one and a half and three inches.

When we look at the depth at which this artery is situated, its great size and proximity to the centre of the circulation, and consider the force with which the blood rushes through it, we cannot but be struck with the success which has attended its ligature. Of 17 cases in which it has been tied, 9 were cured, and 8 died. In 11 of the cases the ligature was applied for aneurism, and of these 7 recovered. The 4 that died, perished rather from the magnitude and extent of the disease than from the effects of the operation, and it is remarkable, as showing the power of the anastomoses in maintaining the vitality of parts, that in no instance did gangrene ensue. In two of the fatal cases, the peritoneum was opened during the operation, and this circumstance doubtless contributed to the fatal result. In both these instances, also, the tumor had been opened before the artery was ligatured, in one by mistake for abscess, in the other by the suppuration and sloughing of the sac.

Ligature of the aorta.—It is impossible not to contemplate with admiration the man whose mind was the first to conceive, and whose hand was the first to carry out the determination to apply a ligature to the abdominal aorta, and who, guided by pathological observation and physiological experiment, dared to arrest at once the circulation through the main channel of supply to the lower half of the body, trusting to the collateral circulation for the maintenance of the vitality of the parts thus suddenly deprived of blood. Sir A. Cooper was the first to place a ligature on the aorta, in 1817. Since that period the operation has been four times performed: viz., by James, of Exeter; by Murray, at the Cape of Good Hope; by Monteiro, at Rio Janeiro; and by Mr. South, of London.

In Sir A. Cooper's case, the inguinal aneurism had burst, and the vessel was tied about three-quarters of an inch above its bifurcation, by making an incision three inches in length through the abdomen, a little to the left of the umbilicus, the fingers being passed between the convolutions of the intestines, and the peritoneum covering the artery scratched through. The patient survived forty hours. James ligatured the aorta much in the same way as Sir A. Cooper did, in a case in which he had previously employed the distal operation for an inguinal aneurism, but without success, the patient speedily dying. Murray ligatured the vessel, by making an incision on the left side, in front of the projecting end of the tenth rib, and carrying it downwards for six inches, to the anterior superior spine of the ilium. The parts were then carefully divided to the peritoneum, which was separated from the iliac fossa and the psoas muscle, when, with great difficulty, and by scratching with the end of an elevator and the finger nails, room was made for the passage of the ligature round the artery,

which was tied three or four lines above its bifurcation. The patient died in twenty-three hours. The most interesting case on record is that by Dr. Monteiro, who tied the aorta for a large false aneurism on the lower and right side of the abdomen; here the incision was made much as in Murray's case, and the artery ligatured with great difficulty. The patient lived till the tenth day, when he died of secondary hemorrhage. In Mr. South's case the artery was tied behind the peritoneum by an incision on the left side of the abdomen. The patient died in 43 hours.

In this operation, there are not only all the dangers attendant upon the ligature of arteries of the first magnitude, but also the risk of producing fatal peritonitis, whether the abdomen be cut through, or the vessel sought for by stripping up the peritoneum from the iliac fossa; and it appears to me that a patient suffering from so large an inguinal aneurism as to justify the ligature of the aorta, would have a better chance of recovery, or rather of prolongation of life, by the adoption of proper constitutional treatment, together with pressure upon the tumor and the distal ligature or compression of the artery.

Ligature of the internal iliac.—Aneurism of the trunk of the internal iliac artery is extremely rare, but its principal branches, such as the gluteal and sciatic arteries, are more frequently affected. The pudic artery is very seldom indeed the seat of this disease, and I am only acquainted with one instance in which it has been met with in this situation, which is exhibited in a preparation in the Museum of the College of Surgeons. The aneurisms of the gluteal and sciatic arteries are more frequently traumatic, than spontaneous. In their symptoms and diagnosis there is nothing peculiar, though these affections have been confounded with pulsating encephaloid tumors of the gluteal region, as in a case in which Mr. Guthrie ligatured the internal iliac artery for disease of this kind.

Since Stevens first tied the internal iliac in 1812, in a negress laboring under gluteal aneurism, this artery has been ligatured six times; of these cases 4 recovered, and 3 died. The success that has hitherto attended this operation is certainly remarkable, when we take into consideration the depth at which the artery is situated and its great size; and must, I think, be accounted for by the fact, that although in these cases the patient runs the ordinary risks attendant on the ligature of the larger pelvic arteries from the exposure and handling of the peritoneum, yet, that he is saved the danger resulting from the supervention of gangrene; the anastomosis between its branches and that of the neighboring vessels being so free, and the course traversed by the blood so short, that no difficulty can arise in the maintenance of the collateral circulation.

The steps of the operation necessary for the exposure of the internal iliac artery are precisely analogous to those requisite for the ligature of the common trunk. When the vessel is reached, it must be remembered that both the external and internal iliac veins are in close relation to it; the one being to its outer side, the other behind it. As these vessels are large, and their coats thin, it is necessary that they should be separated by the finger-nail, or the blunt end of an aneurism needle, before the ligature is passed round the artery; care must also be taken not to put the vessel too much on the stretch in applying the ligature, lest the ilio-lumbar artery be ruptured. As the length of the artery varies much, usually ranging between one and two inches, and as when it is short it has a tendency to be placed deeply in the pelvis, it would, I think, be more prudent, and occasion less chance of secondary hemorrhage, for the surgeon, under such circumstances, to ligature the common trunk

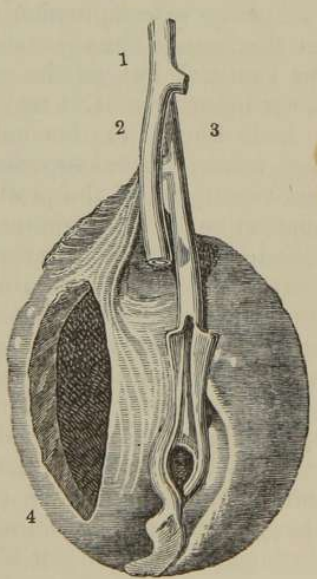
FEMORAL AND POPLITEAL ANEURISMS.

We have, in the preceding section, considered aneurisms affecting the groin, which are by no means of very unfrequent occurrence. Aneurisms of the thigh

are, however, much less frequently met with, but those in the ham are very commonly encountered. Thus, out of 551 cases of aneurism recorded in the British medical journals of the present century, Dr. Crisp has found that 137 affected the popliteal, and only 66 the femoral artery. Of these 66, 45 were situated either in the groin or upper part of the thigh, and 21 only were truly femoral, or femoro-popliteal. The reason of this difference in the frequency of the occurrence of aneurism in different parts of the vessel, may be accounted for by attention to its anatomical relations. In looking at the main artery of the lower extremity, in its course from Poupart's ligament to where it terminates in the anterior and posterior tibials, we see that it may be divided in relation to the muscular masses that surround it into three principal portions. 1st. That which is situated between Poupart's ligament and the anterior margin of the sartorius, which may be considered *inguinal*. 2nd. That which intervenes between this point and the aperture in the adductor tendon, which may be considered *femoral*. And, 3rd, that division of the vessel which corresponds to the ham, and which may be considered *popliteal*. Of these three divisions, the first and last are comparatively superficial, and being unsupported by muscle, readily expand, while the central portion of the artery is closely surrounded on all sides by muscular masses, and is less likely to be dilated into an aneurismal tumor. We also find that the inguinal portion of the vessel is closely and firmly invested by a dense and resistant fibro-cellular sheath, and is well supported by the fascia lata; whilst in the popliteal space the artery is merely surrounded by the ordinary cellular sheath, and receives no aponeurotic support. This difference in the connections of these two parts of the vessel may, to a certain extent, explain the greater frequency of aneurism in the ham than in the upper part of the thigh.

Aneurism of the profunda femoris artery is of extremely rare occurrence; indeed, I am not acquainted with any recorded case. The only instance with which I am acquainted, is that represented in fig. 184, taken from a patient who died of pneumonia, under Dr. Garrod's care, very shortly after admission into the Hospital. On examination after death a large tumor of the thigh, which had not been very closely examined during life, proved to be a circumscribed aneurism of the profunda artery.

Fig. 184.[1]



Femoral and popliteal aneurisms commonly occur about the middle period of life, and are almost invariably met with in males, being at least twenty times more frequent in them than in women. Both sides are affected with equal frequency, and occasionally at the same time. According to Crisp, sailors would appear to be more liable to this variety of the disease than any other class. These aneurisms are most frequently sacculated; in the ham they are always so, but in the thigh they are sometimes tubular.

The *symptoms* of femoral aneurism present nothing peculiar, the tumor usually enlarging with considerable rapidity, with all the characteristic signs of the disease, and assuming a pretty regular ovoid shape. Popliteal aneurism usually commences with stiffness and a good deal of pain about the ham and knee, which I have more than once seen mistaken for rheumatism; there is also a difficulty in straightening the limb, which is generally kept semi-flexed. The tumor increases usually with great rapidity,

[1] 1, Common femoral; 2, superficial femoral; 3, profunda; 4, aneurism.

and has a great tendency to become diffused; these conditions will, however, materially depend on the side of the artery from which it springs; when from the anterior aspect, next the bone, it increases slowly, being compressed by the firm structures before it. In this case, however, there is the great danger that, by its pressure upon the bones and knee, it may give rise to caries and destruction of the joint. When it springs from the posterior part of the artery, where it is uncompressed, it increases rapidly, and may speedily diffuse itself. The diffusion of an aneurism in this situation may take place in two directions. If it be femoro-popliteal, it may give way into the general cellular tissue of the thigh, the blood diffusing itself as high perhaps as Scarpa's triangle. When it is confined to the ham, it may either give way under the integuments, and into the superficial structures of the limb, or else under the deep fascia of the leg, where it will compress the posterior tibial nerve and artery. In all cases the diffusion of popliteal aneurism is likely to be followed by gangrene of the limb.

The *diagnosis* of popliteal aneurism has to be made from chronic abscess, from bursal enlargements, and from solid tumors. From chronic abscess, no serious difficulty can well be experienced; but it may happen that when an aneurism has suppurated, considerable difficulty arises in determining its true nature; whether it is merely an abscess or not. On such cases as these the state of the circulation in the lower part of the limb will throw much light. Bursal tumors, often of large size and multilocular, are not unfrequently met with in the ham, but I have never found any great difficulty in determining their true nature, their elasticity and roundness, together with their mobility and want of pulsation, being sufficiently indicative of their character. The most serious diagnostic difficulty may arise from confounding solidified aneurisms of the ham with solid tumors, either of a sarcomatous character, or springing from the tibia and femur: and I have known one case of aneurism in this condition, in which amputation was performed on the supposition of its being a solid tumor (fig. 163).

The *treatment* of femoral and popliteal aneurism may be conducted either by ligature or compression of the vessel leading to the sac. As a general rule, for the reasons already stated, compression should be employed in preference to the ligature; but yet the cases may arise when, from the failure of compression, or for other reasons, it may be necessary to ligature the femoral artery.

In looking at the femoral artery, it might at first be supposed that the common trunk, situated superficially between the inferior edge of Poupart's ligament and the origin of the profunda, would be the most convenient situation for the application of the ligature; but experience has shown that deligation of the vessel here is in the highest degree unsuccessful. This arises from the shortness of the trunk, rendering it necessary to tie the artery between and in close proximity to those collateral branches that will constitute the most direct and immediate agents in the anastomosing supply, viz., the circumflex ilii and the profunda, so that the internal coagulum would not readily form. In addition to this, however, a number of small inguinal branches, such as the superficial epigastric and circumflex ilii, the superficial and deep external pudic, and very commonly one of the circumflex arteries of the thigh, more especially the internal, arises from the common trunk in its short course, and these vessels, though small in size, constitute a source of great embarrassment to the surgeon during the operation, for if wounded near their origin they bleed most furiously, and are a cause of considerable danger afterwards, by interfering with the proper plugging of the vessel. Of 12 recorded cases, in which this artery has been tied, it would appear that 3 only succeeded, whilst in the remaining 9 instances secondary hemorrhage occurred, which proved fatal in 3, and in 6 was arrested by the ligature of the external iliac. This operation, I think, therefore, ought to be banished from surgery, and in all those cases of aneurism that are situated above the middle of the thigh, and in which sufficient space

does not intervene between the giving off of the profunda and the upper part of the sac for the application of a ligature to the superficial femoral, the external iliac should be tied unless compression can be employed.

LIGATURE OF THE SUPERFICIAL FEMORAL. — The superficial femoral artery, in its course from the origin of the profunda to the aperture in the tendon of the adductor, is divided by the crossing of the sartorius muscle into two portions of unequal length, which have different relations to neighboring structures. The upper division of the artery, which lies above the anterior margin of the muscle, is of most interest to the surgeon, as it is in this part of its course, that it is invariably ligatured in cases of aneurism. It is true that John Hunter, in the operation that he introduced for popliteal aneurism, exposed and tied the vessel in the lower third of the thigh, but his example has not been followed by modern surgeons, on account of the far greater difficulty in reaching the vessel here than in the first part of its course.

The superficial femoral, where it lies in Scarpa's triangle, being merely covered by the common integument, the superficial fascia, and the fascia lata, may be reached by as simple an operation as any that the surgeon has to perform for the ligature of the larger vessels. An incision from three and a half to four inches in length, should be made from a point, two inches below Poupart's ligament, and as nearly as possible midway between the anterior superior spine of the ilium, and the symphysis pubis, and carried downwards in a direction parallel to the axis of the limb. The skin and superficial fascia, having been divided, the fascia lata, which is here very thin, is exposed and opened to the same extent as the incision in the integuments; the inner margin of the sartorius now comes into view, and immediately to the inner side of, and perhaps slightly overlapped by this, is the sheath of the vessels; this must now be cautiously opened, the long saphena nerve being respected, and the aneurism needle unarmed passed between the artery and vein, from within outwards, about four inches below Poupart's ligament; it should then be threaded, withdrawn, and the ligature tied. The edges of the wound must now be brought into contact with a couple of stitches and two strips of plaster; the limb being semi-flexed, somewhat raised, laid on its outer side, and wrapped in soft flannel or cotton wadding. The severe pain which is usually complained of about the knee after the tightening of the ligature, may best be relieved by a full dose of opium.

In this operation there are several points of considerable importance that require special attention. The ligature should always be employed about four inches below Poupart's ligament, so that sufficient space may intervene between the origin of the profunda, which is usually from one or two inches below the crural arch, and the point deligated, to admit of the formation of a proper coagulum in the vessel. It has, indeed, happened that the ligature has been placed within three quarters of an inch of the origin of the profunda, without any injurious consequences resulting. The proper point, however, for the deligation of the artery is that indicated, which is usually the very spot at which the sartorius crosses it; though, if this muscle be very broad, it may be necessary to draw it to the outer side, and the vessel tied below it. In cutting down upon the artery, the saphena vein, or any parallel branch, should if possible be avoided. After the sheath has been opened, it will sometimes be found that rather a large muscular branch is given off from the artery at about the part where it was intended to ligature it; if so, this must be carefully avoided, as well as any small veins that cross the main trunk in this situation.

The femoral vein which lies behind and somewhat to the inner side of the artery, is best avoided by passing the needle from within outwards between the two vessels, the inner side of the sheath being at the same time put upon the stretch by drawing upon it with a pair of forceps. After the needle has been brought up on the outer side of the artery, a small portion of the sheath will

sometimes be found to be pushed up by it; this must be divided by being carefully touched with the point of the scalpel, and the needle thus carried round the vessel.

Wound of the femoral vein is without doubt the most serious accident that can happen in the operation for ligature of the superficial femoral artery, and is one of which there is especial risk when this operation is had recourse to for aneurism, as in this disease the fine cellular tissue which naturally connects the two vessels often becomes thickened and indurated, in consequence of inflammatory action having extended upwards from the sac to the sheath of the vessels. It is best avoided by passing the needle in the way that has been already recommended, unarmed, and without the employment of force. This accident is almost invariably fatal, there being but very few instances on record in which patients have survived it; death usually resulting from diffuse phlebitis, or the supervention of gangrene. The true cause of the fatal result in these cases was first pointed out by Mr. Hadwen, who showed that when the vein is wounded by the aneurismal needle, it is transfixed at two points, between which the thread is drawn across; and when this is tied, a segment of the vein is necessarily included with the artery in the noose. It is this inclusion of the ligature within a portion of the vein, where it acts like a seton, and keeps up constant irritation, that prevents the occurrence of adhesive phlebitis, and occasions diffuse inflammation in the interior of the vessel; and it is consequently this circumstance, and not the mere wound of the vein, that determines the great fatality of this peculiar accident. Guided by this view of the mechanism of the injury, the indications in its treatment become obvious. They consist in removing the ligature at once, and thus, by taking away the main source of irritation, converting the wound into a simple puncture of the vessel, which readily assumes adhesive action. The surgeon should therefore, as soon as the accident is perceived, withdraw the ligature, and opening the sheath about half-an-inch higher up, re-apply it to the artery there. The hemorrhage from the punctured vein readily ceases on the application of a compress.

The ligature of the femoral artery for popliteal aneurism, is an operation that has been so frequently performed, that surgeons seldom think of recording cases of this description, unless they present complications or sequelæ of unusual interest or severity, hence but little importance can be attached to any statistical deductions from reported cases as to the fatality of this operation, although they may serve as a rough estimate of the proportion maintained between the different accidents, such as hemorrhage, gangrene, &c., that follow it. That the ligature of the femoral artery is attended with more success than that of any of the other large trunks, can admit of no doubt. This is not only in accordance with the general experience of surgeons, but is confirmed by the statistics of published cases, even without making allowance for the probability of more of the unsuccessful than successful having been recorded. Thus of 110 instances, collected by Dr. Crisp, in which the femoral artery has been ligatured for popliteal aneurism, only 12 are reported to have died; amongst these, 4 deaths occurred by secondary hemorrhage, 3 by gangrene, and the others by phlebitis, tetanus, chest disease, &c. Higher rates of mortality are, however, given by other authors; thus, Norris states that nearly 1 in 4 die after this operation; Mr. Hutchinson finds that of 33 cases recently operated on in London, 10 were fatal, 5 deaths resulting from gangrene.

The occurrence of *secondary hemorrhage* after the ligature of the superficial femoral is a troublesome accident, and one in which the surgeon, to use Mr. Fergusson's expression, "will most assuredly find himself in an eventful dilemma;" and in which it is necessary that his line of action should have been well considered before-hand, as he may not have much time to spare for reflection when such an event has taken place. In these cases four lines of treat

ment present themselves, viz., the employment of pressure; the ligature of the vessel at a higher point; the deligation of the bleeding apertures in the wound, or amputation of the limb.

Pressure may be applied by placing a graduated compress of lint or compressed sponge over the bleeding orifice, and fixing it there firmly by a horse-shoe tourniquet. This means, although extremely uncertain, occasionally succeeds; should it not do so, however, and bleeding recur a second time, it is useless to continue it, as experience has shown that the hemorrhage will continue until the patient is worn out.

The ligature of the superficial femoral at a higher point, or if the artery has been tied too high for this, the deligation of the external iliac, presents itself as a probable means of arresting the hemorrhage. Such an operation, however, is fraught with danger, and has, I believe, invariably been followed by gangrene of the limb. It might at first be supposed that the limb would not be placed in a worse situation after the ligature of the external iliac, whether the superficial femoral had been previously tied or not, the anastomosing channels remaining the same in either case. But in reality it is not so; for although the blood might find its way through the epigastric, the circumflex ilii, the gluteal and sciatic arteries, into the profunda and its branches, yet from this point the difficulty of its transmission through the limb would be materially increased. If the superficial femoral be open, it serves as a direct and easy channel for the conveyance, to the vessels of the leg and foot, of the blood brought by the anastomoses. But when the superficial femoral is tied, this blood must find its way through a second chain of anastomosing vessels,—those intervening between the branches of the profunda and the articular arteries of the knee; and here the real difficulty would arise, its impulse not being sufficient to overcome the obstruction to its passage through these small channels, which might not improbably be still further obstructed by the pressure of the aneurism. Should the anastomosing circulation be sufficiently free to maintain the vitality of the limb, it is not improbable that the recurrent blood would escape from the distal side of the ligature, and thus keep up the hemorrhage exactly as in a case of wound. It appears indeed that the femoral artery, in a case of secondary hemorrhage after the application of the ligature, is in very much the same condition as an artery which has been wounded, and in which the bleeding, having been suppressed for some days, has returned with violence; and I think the best course for the surgeon to pursue is the same practice that he would follow in the event of secondary hemorrhage occurring from a wounded vessel, viz., by cutting down upon the bleeding part and applying a ligature to it. That such an operation is surrounded with difficulties cannot be doubted; but yet none would present themselves that care and skill might not overcome. The surgeon would certainly have to cut into a part infiltrated with blood, in which the different tissues could not readily be distinguished, and the vessel when reached would be found to be soft, friable, and granulating, yet by free dissection above and below the wound, a portion of it might at last be exposed, where its coats would hold a ligature; or should this not be found, the wound might be firmly plugged from the bottom with compressed sponge; or the bleeding aperture touched with the actual cautery. Should these means fail, it would, I think, be safer to amputate the limb, than to endeavor to arrest the hemorrhage in any other way.

Gangrene of the limb is perhaps the most frequent source of danger after the ligature of the femoral artery for popliteal aneurism. It seldom occurs, however, unless the tumor be of considerable magnitude, have become diffused, or otherwise interfere seriously with the circulation through the limb. I have, however, seen it follow after the operation where the popliteal aneurism had not attained a larger size than that of an orange; but, in this case, there was much œdema of the limb, and congestion of the veins before the operation, and on

examination afterwards, it was found that the popliteal vein had been obliterated by the pressure of the tumor. The gangrene may, in some cases, be prevented by the treatment that has been pointed out at page 176. When it has fairly declared itself, there is necessarily no resource left but amputation, and this operation is sufficiently successful; for I find that of 14 cases in which it was done there were 10 recoveries, and but 4 deaths.

The *return of pulsation in the sac* after the operation for popliteal aneurism is by no means of frequent occurrence, but yet, it has been met with in some instances, and secondary aneurism has also been found in this situation. In these cases the patient should be put upon a careful dietetic plan, the limb be kept elevated and at rest, and pressure applied by means of a compress and bandage, or a horse-shoe tourniquet. In this way cures have been effected by Wishart, Turner, Briggs, and Liston. In conjunction with such treatment, or in the event of its not sufficing, the compression of the common femoral artery as it passes over the pubes, would in all probability effect a cure. Should it not do so, and the tumor continue to increase, threaten to suppurate, or to occasion gangrene, amputation would be the sole resource.

In the case of *double* popliteal aneurisms, the artery has been occasionally ligatured with advantage on both sides, either simultaneously, or, more safely, consecutively. But these cases appear to me to be especially adapted for the employment of pressure, so as to avoid that disturbance of the balance of the circulation which is certain to ensue when one vessel is ligatured, and which may act injuriously upon the opposite aneurism. When the popliteal aneurism is conjoined with a similar disease of the groin, the ligature of the external iliac is the proper course to pursue, and will effect a cure of both affections.

When a *circumscribed* popliteal aneurism suddenly becomes *diffused*, the patient is seized with faintness or sickness, with pain, numbness, and a hot trickling sensation in the limb, the temperature of which falls at the same time that its bulk increases, and the integument assumes a white, shining, mottled appearance, with more or less purplish discoloration. This condition usually occurs after a circumscribed aneurism has existed in the ham for some weeks or months, and on the occurrence of some sudden exertion. In some cases, however, the disease appears to have been diffused from the very first, the coats having given way, and extravasation having taken place into the cellular tissue of the limb, without the previous consolidation of the parts around the artery, or any attempt at the formation of a sac. In these cases the extravasation into the limb may either be conjoined with much œdema, or it may be confined to the cellular tissue of the ham, and to the upper and back part of the leg, or extend downwards under the muscles of the calf. When the patient comes under the observation of the surgeon, the tumor is found to be solid, elastic, and irregular, without pulsation or bruit, the limb œdematous, cold, and congested. The diagnosis of this form of aneurism is often extremely difficult, and there is great danger of confounding it with simple extravasation into the calf, with abscess, or, possibly, with malignant tumor of the leg.

The danger attending on popliteal aneurism is greatly increased by its becoming diffused. Under these circumstances the ligature of the artery usually affords but a slender prospect of success, the collateral vessels being so compressed and choked by the pressure of the effused blood as not to admit of the circulation being carried on through them; hence, in many of these cases, the only resource left is amputation.

The question of amputation in cases of diffused popliteal aneurism is not very easily submitted to any very positive or definite rules, except in those instances in which the impending gangrene is so evident as not to admit of doubt. There are, however, certain general considerations that may guide the surgeon in coming to a decision on this point.

In some cases the sac has either given way to a very limited extent, or else its

walls having become thin and expanded, are yielding rapidly under the pressure of the blood, becoming fused with the surrounding parts. Here we should ligature the artery without delay; for, although it is but seldom that a limb can be saved when once the blood has become infiltrated into the general cellular tissue, yet it is possible, such a fortunate occurrence may happen.

In other instances the aneurism has not from the first been very distinctly circumscribed. It has followed the infliction of some mechanical injury, and in the course of a week or two has acquired a considerable size, without definite or distinct limitation, being solid or but little compressible. Such a case as this can scarcely be considered, strictly speaking, a diffused aneurism; but yet, if by *circumscribed* we mean that the blood is contained in a defined cyst with walls, it scarcely complies with such a definition, the fluid blood being rather prevented escaping widely by a temporary barrier of coagula entangled in the loose cellular tissues of the part, and the vessel being ruptured to a considerable extent, or completely torn across. Here we are certainly justified in having recourse to compression or ligature with a good prospect of success.

When the ham is occupied with a large, rapidly-increasing tumor, extending perhaps some way down the calf and up the thigh, and encroaching on the knee, the skin covering it being more or less discolored, there being no pulsation perceptible in the tibials, and the veins of the limb being full and even somewhat congested, the foot œdematous, and several degrees in temperature below that of the opposite limb, the difficulty of coming to a decision is considerable.

In such a case as this, I think the existence or non-existence of pulsation of a distensile character would be a circumstance of very great importance, and may serve to guide the surgeon.

If there be distinct impulse of a distending character, which can be arrested by compression of the femoral artery, with some diminution of the size of the tumor, it is an evident indication of the transmission of blood through the sac, and that this contains some fluid blood. Under these circumstances, it will, when the artery is tied, subside to a considerable extent, thus allowing more space for the conveyance of the collateral circulation, and it would be but right to give the patient the chance of preserving his limb by ligaturing the vessel.

If, however, the tumor have, from the very first that it attracted the patient's notice, been more or less solid and incompressible; and though it may at an early period of its existence have pulsated, if this pulsation has suddenly ceased, the aneurism at the same time having undergone rapid and great increase of bulk with much tension and lividity of the integuments, œdema and coldness of limb, with a tendency perhaps to vesication and ulceration of the skin covering the tumor, there is no resource left but amputation.

It must, however, be borne in mind that the aneurism may become diffused, and extensively so, without any very great change in the shape and size of the limb. It is only when the sac ruptures in such a position that the blood is effused into the general cellular tissues of the limb or under the skin, that much tension of the integuments and increase in the bulk of the part takes place.

When the rupture occurs in a part of the sac that is more deeply seated, so that the blood is extravasated underneath the deep fascia of the leg, it is bound down by this and the superincumbent muscles, and deep-seated disorganization of the limb may be the result, without much, if any, change in its bulk or in the color of the integuments, but with deep-seated pain, which is excessive. There must always be considerable risk in such a case as this of confounding the arterial disease with solid tumor, and the diagnosis can only be effected by a reference to the early history of the case, and more particularly to the existence or not of pulsation at this period. Indeed, the existence or non-existence of pulsation in these cases, is of the very utmost importance in reference to the question of treatment. The pulsation may have ceased in a case of diffused popliteal aneurism, in consequence of the

blood that has been extravasated being so confined and bound down by the fascia and muscles under which it is effused, that it compresses or seals the mouth of the artery leading into the sac, to such an extent as to arrest the passage of blood through it, either wholly or so that it enters in a feeble stream, of insufficient force to communicate impulse to the fluid that has been extravasated into the limb. This pressure may, as in the case of which an illustration has been given (fig. 170), be confined to the deep parts of the limb and not give rise to much, if any, general tension of it, the blood being confined below the deep fascia, where it communicates the sensation of a hard solid elastic tumor, devoid of pulsation; attention should consequently not be too exclusively directed to the state of general tension of the surface of a limb, as this is by no means necessarily an indication of the state of the parts beneath. But the surgeon should rather look to the presence or absence of pulsation. If pulsation still exist, the blood continues to find its way into the sac, and most probably through it, the tension of the parts not having yet reached its maximum. If there be no pulsation, he may be sure that the entrance of blood into the diffused aneurism has ceased in consequence of compression exercised on the mouth of the artery leading to it, by the tense condition of the surrounding and enveloping tissues re-acting on the mass of blood effused beneath them. In such a state of things as this, the vitality of the lower part of the limb can only be maintained by the blood that may find its way through the anastomosing channels; and this may, if the tension of the limb be not general, the extravasation being confined to below the deep fascia, be sufficient for this purpose. If surgical interference be delayed in such a case as this, the deep fascia will soon give way by rupture or ulceration, and the blood will be infiltrated into the general cellular tissue of the limb, and then, by compressing those collateral branches that have hitherto maintained a feeble circulation in it, will infallibly occasion gangrene. If, on the other hand, ligature of the main artery be had recourse to, the anastomosing circulation, which may have been barely sufficient to keep up a feeble vitality in the leg and foot, will be so much interfered with that gangrene of the limb inevitably ensues. The only resource, therefore, that is left in these cases is to amputate at once, in order that the patient may be saved the shock of the constitutional disturbance occasioned by the setting in of mortification, as well as the pain and risk of a previous unnecessary operation.

When gangrene threatens; the leg and foot having become cold, the skin being either pale, tallowy and mottled, or discolored, of a purplish hue, with perhaps vesications and much œdema, whether the ligature have been previously applied to the femoral artery or not, or (whatever the condition of the aneurism may be, whether circumscribed or diffused,) the patient will stand a better chance of ultimate recovery by having the limb removed at once above the knee. The part at which amputation should be performed is a point deserving some consideration in these cases. If the femoral artery have been ligatured, the thigh should be amputated on a level with the ligature, the artery being cut just above this. In this way the double risk that the patient would otherwise run of secondary hemorrhage from the seat of the ligature, as well as from the face of the stump, will be reduced to a single chance of hemorrhage from the stump. If the amputation be the primary operation, it should be done at the lower third of the thigh, provided the extravasation be confined to below the knee; or higher up, if the effused blood have extended above this joint.

Aneurisms of the tibial arteries are extremely rare, except as the result of wound, but yet they are occasionally met with; and in the museum of St. George's Hospital is a preparation of a small aneurism of the posterior tibial. These arteries may, however, require ligature either for injury or disease.

Ligature of the tibial arteries. — The *posterior tibial artery* may be

tied in two parts of its course; either behind the ankle or in the calf of the leg. Behind the ankle, it may be reached by making a semilunar incision three inches long, about three-quarters of an inch behind the inner malleolus, towards which its concavity should look. After dividing the integument and superficial fascia, the deep fascia, which is usually single, but may be double, must be laid open; this closely invests the vessel, nerve, and tendons in this situation; under it the artery will be found, accompanied by two veins, from which it must be separated before the ligature is passed. Anterior to the vessel, and nearer the bone, are the tendons of the flexor digitorum communis, and tibialis posticus; behind, is the nerve and the tendon of the flexor proprius pollicis.

In the middle of the leg, the posterior tibial artery should only be tied for wound in that situation. Under such circumstances no regular operation can be performed, but an incision of sufficient length, taking the wound for its centre, should be made through the gastrocnemius and soleus, parallel to their fibres, when, after these have been cut through, the deep fascia will be exposed. This must next be opened, when the artery will be found, accompanied by its veins, and having the nerve to the outer side. From the depth at which the vessel is situated, and the free incisions that it is necessary to make through muscular parts, it is extremely difficult to apply the ligature in this situation. The later steps of the operation may be much facilitated by flexing the leg on the thigh, and extending the foot so as to relax the muscles.

The *anterior tibial* may be tied in several situations, but the same remark applies to this as to the posterior tibial, that it should not be ligatured except for injury. The difficulties of the operation are lessened as the ankle is approached, where the artery becomes superficial, and may easily be secured. In the upper third of the leg it lies deep between the tibialis anticus and extensor communis digitorum muscles, surrounded by veins, and having its nerve to the outside. If it be ever found necessary to tie it in this situation, the incisions requisite to expose it should be made at least four or five inches in length, and especial care should be taken not to cut into the muscular substance, but to get into the first intermuscular space to the outside of the tibia, at the bottom of which the vessel will be found. In the middle third of the leg, the artery is crossed by the extensor pollicis, and will be found between the tibialis anticus and this muscle; it is best reached here by keeping well to the outside of the tibialis anticus.

The *dorsalis pedis* may be felt pulsating, and may readily be secured, as it runs forwards from the ankle joint to reach the space between the first and second metatarsal bones, lying between the tendon of the extensor pollicis and that of the extensor brevis digitorum.

CHAPTER XXXVIII.

ANEURISMS OF THE NECK AND UPPER EXTREMITY.

ANEURISM OF THE INNOMINATA.

Aneurisms of this artery may either be of the tubular or the sacculated kind, and usually give rise to a train of serious and dangerous symptoms from their pressure upon important parts in their neighborhood. Indeed, a glance at the relations of this artery will show the important effects that must be produced by the pressure of a tumor springing from it. Before it lie the left innominata

vein and the superficialis cordis nerve; to its left is found the trachea, and more posteriorly, the œsophagus; on its right are the innominata vein of that side, and the summit of the pleura costalis; externally and posteriorly it is in relation with the par vagum, and more posteriorly and internally it lies before the right recurrent laryngeal nerve.

The general *symptoms* of an aneurism of this artery are the existence of a pulsating tumor of a globular shape behind the right sterno-clavicular articulation, attended with pain, and, perhaps, œdema of the right side of the face and arm, with some difficulty in respiration, laryngeal cough, and dysphagia. The tumor is usually soft and compressible, filling up more or less completely the hollow about the sternum, and even rising as high in the neck as the lower margin of the cricoid cartilage; it pushes forwards, first the sternal, and afterwards the clavicular portion of the sterno-mastoid muscle, and has occasionally been seen to extend into the posterior inferior triangle of the neck; and indeed is generally most distinctly defined towards its brachial aspect. In some cases no tumor rises into the neck, but the sternum, clavicle, and costal cartilage of the first rib, are found to be considerably pushed forwards beyond their natural level. In the space around the right sterno-clavicular articulation, and about the upper part of the sternum, there will be dulness on percussion. In very many instances there is no bruit, but merely a strong impulse with the heart's sounds, as distinct or even more so than in the cardiac region, but in other cases there is every variety of bruit.

The most important symptoms are occasioned perhaps by the pressure effects of the tumor upon the neighboring parts, affecting the pulse, the venous circulation, respiration, and deglutition.

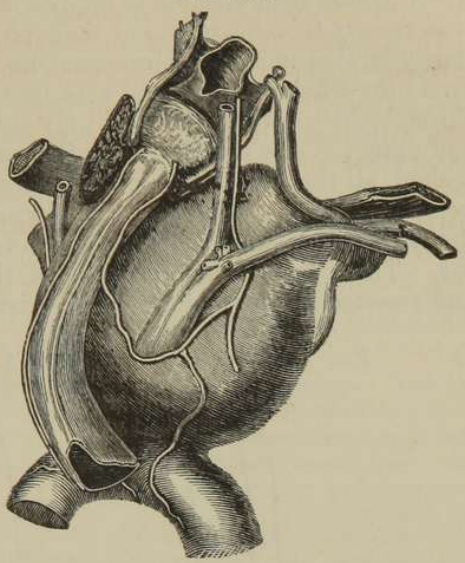
The pulse is usually influenced, being much smaller and feebler in the radial artery of the affected than of the sound side, and in some instances being completely arrested; owing, doubtless, to the occlusion of the subclavian. The pulsation in the right carotid and its branches is also frequently much less powerful than in the opposite vessel; these signs commonly occur before any external tumor is seen or can be felt, and hence constitute an important element in the early diagnosis of the disease.

Enlargement of the superficial veins of the neck and right upper extremity is of frequent occurrence, the external jugular being the vessel that is usually first dilated; at a more advanced period the superficial subcutaneous veins of the upper part of the right side of the chest often become tortuous, and form a dense plexus in this situation, while many anastomose with the cephalic and thoracic veins above, and the superficial epigastric below. As the pressure increases, œdema commences in the right eyelids and hand, and may speedily extend to the whole of the head, face, and arm, which become hard and brawny in consequence of serous infiltration. In one case I have seen the left arm become suddenly œdematous, the left innominata vein being pressed upon. In these cases the eyes become staring and prominent, and the lips, nose, and features livid and turgid with blood, as well as œdematous, so as materially to alter the patient's expression of countenance.

Pain of a dull aching character is experienced in the situation of the tumor, from the compression of the neighboring structures. But early in the disease, and among some of the first symptoms, the patient often experiences sharp shooting pains, apparently of a rheumatic or neuralgic character, in the arm and the side of the head and face. This is from pressure upon, and irritation of, the cervical and brachial plexuses of nerves, and taking the course of the ascending and descending filaments of the former, the pain shoots up the side of the head and neck, over the shoulder and upper part of the chest; or, from pressure upon the brachial plexus, radiates down the hand and arm, being usually especially severe about the elbow and fingers. At the same time the muscular power of the right arm commonly becomes impaired.

Dyspnœa is of very common occurrence, and very varying degrees of intensity, from slight difficulty in breathing up to fatal asphyxia. It may proceed either from irritation of the larynx, in consequence of compression of the recurrent nerve; or, from pressure on the trachea, or the right bronchus. When dependent on laryngeal irritation, the voice is hoarse, husky, or whispering; and there is a dry, croupy, and paroxysmal cough, usually accompanied by expectoration of frothy serous mucus. In these cases, after death the recurrent nerve will be found to be stretched out and greatly elongated by the pressure of the tumor (fig. 185). Compression of the trachea, which becomes flattened and curved over to the left side by the protrusion of the tumor, is a common cause of dyspnœa, and is not unfrequently associated with the laryngeal irritation. More rarely by far, the right bronchus is compressed by the extension of the tumor downwards.

Fig. 185.



Aneurism of the innominata artery, compressing and stretching the recurrent laryngeal nerve, and pushing the trachea to the left side. (Back view.)

Dysphagia is of sufficiently frequent occurrence, and varies from slight uneasiness in deglutition to an impossibility in swallowing anything except fluids. I have never seen it occur without its having been preceded by dyspnœa; and in every instance that has fallen under my observation, it has been associated with laryngeal irritation. This coincidence of these two symptoms is readily explained by the anatomy of the parts; the recurrent nerve lying as it does between the artery and œsophagus, must suffer compression before the mucous canal can be interfered with.

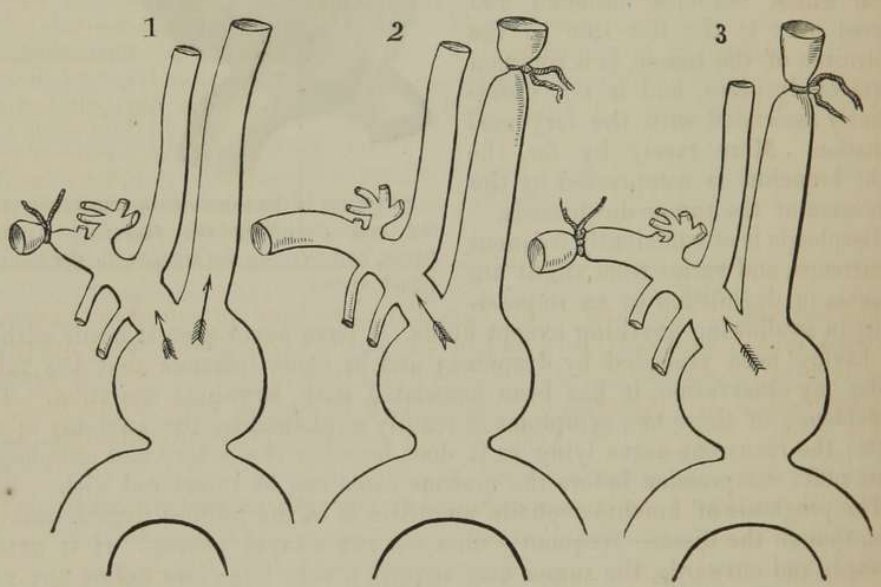
The prognosis of brachio-cephalic aneurism is in the highest degree unfavorable, though the disease frequently does not run a rapid course. If it extend upwards and outwards, the tumor may acquire a very large size before any very important organ or part is implicated; but if it press backwards and inwards, it may prove fatal at an early period. I know of no case in which such an aneurism, if left to itself, has undergone spontaneous cure, and but few instances in which the rupture of the sac has taken place. The most frequent cause of death is by asphyxia, from spasmodic closure of the larynx induced by irritation of the recurrent nerve; or by pressure on the trachea.

Treatment. — There are several instances on record in which a properly conducted course of constitutional treatment has cured a patient; thus a case of Mr. Luke's was permanently cured by small and repeated bleedings, conjoined with the administration of digitalis. In connection with such treatment, distal pressure might be employed, as in a case that derived benefit from this plan in Mr. Syme's hands.

In aneurism of the innominata, the vessel is so short and the sac so situated, that it is impossible to attempt to apply a ligature on the cardiac side of the tumor. What resource then does surgery offer in these cases beyond the employment of constitutional and dietetic means? It may be answered to this, that if these measures fail in arresting the disease, our choice must lie between two alternatives; leaving the patient to his fate, or having recourse to the application of the ligature on the distal side of the tumor. On looking on the innominata artery with reference to the distal operation, we are struck by two

peculiarities in the vessel, which must necessarily modify to a considerable extent not only the seat of the operation, but the principle on which it is conducted. The first peculiarity to which I allude is the shortness of the trunk, which makes it impossible to apply the ligature to the vessel itself, but renders it necessary to deligate one or both of its terminal branches. The other peculiarity is, that under no circumstances can these vessels be so ligatured as to arrest the whole of the blood sent into the artery; for although the circulation through the carotid may be entirely stopped, yet it is impossible, from the seat and extent of the disease, to tie the subclavian at any point except beyond the scaleni, all that blood which is destined for the supply of the branches of this vessel — viz., the vertebrals, the thyroid axis, the internal mammary, and the first intercostal, must therefore continue to be propelled into and through the sac. Three distinct modifications of the distal operation have been proposed and resorted to for the cure of aneurisms in this situation. 1st, the ligature of

Fig. 186. Fig. 187. Fig. 188.



the subclavian alone; 2nd, of the carotid alone; and, 3rd, of both vessels, with an interval of greater or less extent.

The ligature of the subclavian only (fig. 186) has been practised in 3 cases, the results of which are exhibited in the accompanying table; 2 were fatal, and the partial success of the third may be fairly attributed, in a great measure, to the accident of the carotid being occluded. The results of this practice have certainly not been sufficiently favorable to justify the surgeon in repeating an attempt of this kind, opposed as it is to the known principles on which the distal operation effects a cure. For supposing, as we may safely do, with Mr. Wardrop, that only one-third of the blood that is sent into the innominata finds its way through the extra-scalenal portion of the subclavian, the remainder being destined for its branches and the carotid in equal proportions, what fact can be adduced or principle laid down by which we can expect to obtain the cure of an aneurism in close proximity to the heart, by cutting off so small a proportion as one-third of the supply of the blood sent into it?

ANEURISMS OF INNOMINATA TREATED BY LIGATURE OF SUBCLAVIAN ONLY.

OPERATOR.	SEX.	AGE.	RESULT.	CAUSE OF DEATH.	REMARKS.
1. Dupuytren.	m.	40.	Died on ninth day.	Exhaustion, following cough, and secondary hemorrhage.	Subclavian ligatured immediately above clavicle, tumor diminished, but pulsations continued. Aneurism of subclavian, with dilatation of innominata and aorta.
2. Laugier.	m.	57.	Died a month after operation.	Asphyxia.	Vessel ligatured immediately above clavicle. Aneurism of brachio-cephalic; aorta was dilated, and right carotid obliterated by the pressure of the tumor.
3. Wardrop.	f.	45.	Died two years after operation.	Exhaustion.	Subclavian ligatured beyond scaleni; the pulsations in and size of tumor diminished, and respiration became freer; on the ninth day pulsation reappeared in right carotid, in which it had previously been absent. (We may ascribe success of operation to this circumstance.)

The ligature of the carotid only (fig. 187) has been practised in 9 cases, as recorded in the annexed table, and in 1 case only does the disease appear to have been materially benefitted, and in that instance the good effects can scarcely be attributed to the operation, but must rather be looked upon as an effort of nature to effect a spontaneous cure, the sac becoming inflamed and suppurating,

ANEURISMS OF INNOMINATA TREATED BY LIGATURE OF CAROTID ONLY.

OPERATOR.	SEX.	AGE.	RESULT.	CAUSE OF DEATH.	REMARKS.
1. Evans.	m.	30.	Recovered.		The tumor diminished for a few days after operation, but at the end of seven days inflammation of the sac set in, followed by obliteration of the arteries of the right upper extremity and the branches of the carotid. At the end of a year the tumor still existed, with constant pulsation. The next year the sac suppurated and discharged much pus. Disease arrested, but not cured.
2 Mott.	m.	55.	Died seven months after operation.	Asphyxia.	After the operation the radial pulse in the affected side disappeared, and the tumor in the neck was much diminished. After death, no external appearance of tumor, but internally it was as large as a double fist.

ANEURISMS OF INNOMINATA TREATED BY LIGATURE OF CAROTID ONLY.

OPERATOR.	SEX.	AGE.	RESULT.	CAUSE OF DEATH.	REMARKS.
3. Aston Key.	f.	61.	Died a few hours after operation.	Narrowing of vertebral arteries, brain not receiving sufficient blood for the maintenance of its functions.	Aneurism of innominata and of arch of aorta found. The orifice of left carotid nearly occluded, and vertebrals smaller than natural.
4. Fergusson.	m.	56.	Died on seventh day.	Pneumonia	Tumor and pulsation decreased after operation. Tumor nearly filled with firm laminated coagulum; no plug in carotid.
5. Morrison.	m.	42.	Recovered from operation, died twenty months afterwards.	Suddenly, cause not stated.	Aneurism of innominata and carotid found. Arch of aorta diseased. Right carotid dilated into a sac as high as part ligatured, and plugged by dense fibrinous laminæ.
6. Campbell	m.	48.	Died on nineteenth day.	Pneumonia.	Tumor began to disappear after the vessel was ligatured. After death, aneurism of innominata and transverse portion of arch, and dilatation of descending aorta as far as diaphragm were found.
7. Hutton.	m.	47.	Died on sixty-sixth day.	Bronchitis, inflammation, suppuration, and ulceration of sac, into trachea.	Tumor diminished after ligature. Size and pulsation less. After death, tumor contained purulent matter, and grumous blood; had opened into trachea. Right carotid and subclavian contained firm coagula.
8. Dr. Wright, (Montreal.)	m.	70.	Died on sixtieth day.	Hemiplegia.	Tumor solidified by laminated fibrine. Subclavian pervious with canal through tumor leading to it.

and the arteries of the arm and head on the side affected having been obliterated. Mr. Key's patient died in consequence of the left carotid being occluded, and the brain being deprived of its proper supply of blood.

In 3 cases both the carotid and subclavian arteries have been tied (fig. 188). In the most favorable of these, that by Fearn, two years elapsed between the ligature of the carotid and that of the subclavian, the patient dying three months after the second operation, the sac apparently filled with laminated coagulum, and appearing to be undergoing spontaneous cure. The third case is remarkable as being the only instance in which both the vessels were tied simultaneously, and from the patient having lived for six days after the occlusion of all the arteries supplying the brain except the left vertebral.

ANEURISMS OF INNOMINATA TREATED BY SUCCESSFUL LIGATURE OF CAROTID AND SUBCLAVIAN.

OPERATOR.	SEX.	AGE.	CAROTID LIGATURED.	SUBCLAVIAN LIGATURED.	REMARKS.
1. Fearn.	f.	28.	Carotid ligatured, Aug. 30th, 1836.	Subclavian ligatured, Aug. 2d, 1838.	Died three weeks after second operation from pleurisy. Sac of aneurism of innominata filled with dense organized coagulum; except a channel the size of artery for the passage of the blood.
2. Wickham.	m.	55.	Carotid ligatured, Sept. 25th, 1839.	Subclavian, Dec. 3rd, 1839.	Tumor diminished after ligature of carotid, and dyspnœa ceased for a time, but symptoms returning, subclavian was tied. Relief of symptoms ensued, but tumor increased, and patient died two and a half months after first bursting of the sac.
3. Rossi.			Carotid and subclavian.	Simultaneously.	Death in six days. Occlusion of left carotid and right vertebral arteries; circulation of brain carried on by left vertebral merely.

Having thus given a *resumé* of the cases of aneurism of the innominata, in which the operation of ligaturing the artery beyond the sac has been performed, the question arises whether any or all of these operations should retain a place in surgery. This question may be examined in two points of view: 1st. As to the principle on which these operations are performed; and 2nd. As to their results in practice. For the success of the distal operation, it is requisite either that there be no branch given off from the sac, or between it and the ligature; or that the current of blood through the sac may at least be so far diminished as to admit of the deposition of laminated fibrine in sufficient quantity to fill it up by a process similar to what happens in a case of aneurism treated by the Hunterian method. In order that this be accomplished, it is certainly necessary that the greater portion of the blood passing through it be arrested, for if the current that is still kept up through it is too free, the tumor will continue to increase, as we have seen happen in those cases of inguinal aneurism in which the femoral artery is ligatured below the epigastric and the circumflex ilii, the current through which is sufficient to feed the sac in such a way that a cure could not be accomplished. If, therefore, but one of the vessels leading from the brachio-cephalic, as the subclavian beyond the scaleni, be tied, and but a third of the blood circulating through the main branch be arrested, are we justified in hoping that the circulation through the sac would be so influenced by the deprivation of this small quantity, that the remaining two-thirds of the blood, which would still pass through for the supply of the carotid and the branches of the subclavian, would gradually deposit those fibrinous laminæ, by which obliteration of the tumor is to be effected? Should we not rather expect that the larger current would be too powerful to allow of the formation of these layers, and would continue to distend the sac in such a way as to prevent its contraction? Surely if the comparatively small and feeble streams of blood, that pass through the epigastric and circumflex ilii, are sufficient to interfere with the cure of an inguinal aneurism after the distal ligature of the femoral,

the strong current that sweeps through the carotid and large branches springing from the subclavian with the full force derived from close proximity to the heart, will be sufficient to prevent all lamination in an aneurism of the innominata. That the arrest of the circulation through one of these vessels only, is not sufficient to influence materially the growth of the aneurism, is evident likewise from what is not unfrequently observed after death in cases of this kind — one or other of the vessels being found compressed and obliterated by the pressure of the sac, and yet no alteration in the tumor resulting. These cases, which are tolerably numerous, would of themselves have been sufficient to have proved that something more than this amount of obstruction is required in order to effect proper stratification of fibrine in the sac; and if we turn to the result of the twelve cases, in which either the carotid or the subclavian has been ligatured, we shall find that in one case only, that operated on by Mr. Evans, of Belper, has a cure been effected; and in this instance how was it accomplished? According to the principle on which it was attempted to be established? Certainly not, but as will be seen by attention to the details of the case, and as has been already pointed out with much acuteness by Mr. Guthrie, by the accidental setting up of inflammation in the artery extending to the sac, and thus obliterating it.

In the only case, that of Mrs. Denmark, in which Mr. Wardrop tied the subclavian for the cure of aneurism of the brachio-cephalic, there is some reason for doubt whether the arrest of the progress of the tumor was owing to the ligature of the subclavian artery, or whether it was not much influenced by the obstruction which existed in the carotid for nine days after the operation, during which time so abundant a deposit of laminated fibrine might have occurred as to arrest the progress of the disease for some length of time. In this case, also, Mr. Guthrie supposes it probable that the obliteration of the tumor might lead to its inflammation.

From a careful consideration of all the circumstances of the cases in which ligature of one vessel only has been employed for brachio-cephalic aneurism, we are I think fully justified in concluding that in 6 of the cases the fatal result was much accelerated, occurring as a consequence of the ligature of the vessel; in 2, the progress of the disease was in no way interfered with; in 1 it was arrested, the patient living for two years; and in 1 case only the disease was cured. The improvement in the 2 last cases was the result of accidental circumstances, which were unexpected and unconnected in any way with the principles on which the operation was undertaken. These results would not in my opinion justify any surgeon in again undertaking either of these operations.

We have yet to consider the operations in which both arteries are ligatured. This double operation may either be performed with an interval between the application of the two ligatures, sufficient for the establishment of a collateral circulation; or, the two vessels may be ligatured simultaneously. The former plan has been adopted in two cases, the latter only in 1; not a sufficient number for any safe deduction. In 1 of the 2 cases in which an interval intervened between the two operations, that by Mr. Fearn, the tumor seems to have undergone a cure, being filled with dense laminated fibrine; but the patient died eventually of pleurisy. In other cases, by Mr. Wickham, no good results followed the operation, death occurring from bursting of the tumor. In the case in which both vessels were ligatured simultaneously, death occurred in consequence of the left carotid and right vertebral being accidentally occluded, and the cerebral circulation being then solely dependent on the left vertebral. As I have just said, these cases are not sufficiently numerous or free from modifying circumstances to enable us to draw any inference from them, we must therefore revert to the principle on which this operation should be undertaken. This will differ materially according to whether the two arteries are ligatured simul-

taneously, or with a sufficient interval for the re-establishment of collateral circulation.

If an interval of two years, as in the first case, or even of two-and-a-half months, as in the second instance, be allowed to elapse between the ligature of the carotid and that of the subclavian, the operation reduces itself essentially to that of the ligature of a single artery, which, as has already been shown, is insufficient to induce these changes in the sac that are necessary for the accomplishment of a cure. If the patient survive the effect of the ligature of the carotid for a few weeks, sufficient time will be afforded for the proximal end of the subclavian, the vertebral artery, and the thyroid axis to have taken upon themselves a great increase of development, — the collateral circulation being carried on by them and not by the left carotid; so that by the time that the subclavian comes to be ligatured beyond the scaleni, the sac will still continue to be traversed by a current of blood for the supply of the branches of the subclavian, dilated to much beyond their normal size, in consequence of the task of supplying the right side of the neck, face, head, and brain, being principally thrown upon them. This current through the proximal end of the subclavian, increased as it would be by the whole of that blood which is destined to supply the place of that which should pass by the carotid, would place the sac in nearly the same condition as if the subclavian also had been ligatured, and would consequently, for the reason that has already been given, be too powerful for us to expect a cure to take place in the course of its stream.

It now remains for us only to consider the simultaneous ligature of both vessels — an operation that has been but once performed, and then under such circumstances as to preclude our reasoning upon it, the patient having died from accidental occlusion of the left carotid and right vertebral arteries. In reasoning upon the simultaneous ligature of the two vessels, we must consider two points—1st. In what conditions do we place the sac? And, 2d, Is the danger of the patient much increased?

So far as the sac is concerned, it is impossible to place it in a better condition for the deposit of fibrinous matter; two-thirds of the blood flowing through it being arrested, and that only traversing it which is destined for the supply of the branches of the subclavian. It is by no means improbable that even this stream may yet be too large and forcible to allow the process of occlusion to take place; but yet it is impossible still further to diminish it, and if the aneurism be sacculated, and project from one side of the artery, particularly if to its internal or mesial aspect, it is by no means impossible that it might be sufficiently removed from the stream to allow of consolidation of its contents.

Would it add to the danger of the patient to ligature these two vessels simultaneously rather than separately? I think not: if the risk of a double operation is to be incurred, I cannot think that it would be positively increased by the two being performed at once, instead of at separate intervals. The whole of the vessels that serve to maintain the collateral circulation in the head and upper extremity — the vertebral, inferior thyroid, supra and posterior scapular, and cervical, being left uninterfered with.

ANEURISM OF THE CAROTID.

Aneurismal varix of the carotid artery and of the jugular vein, as the result of punctures and stabs in the neck, has been met with in a sufficient number of instances to establish the signs and treatment of such a condition; and an instance is related by Mr. Macmurdo, in which a communication was established between these vessels as the result of disease; but I am not acquainted with any case of *varicose aneurism* of these vessels having been recorded. The signs of aneurismal varix in this situation present nothing peculiar, and the treatment must be entirely of a hygienic character, no operative interference

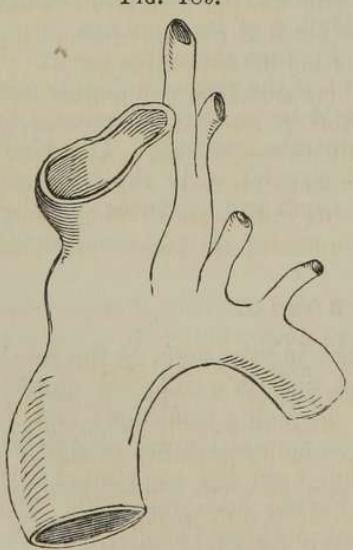
being likely to be attended by any but a fatal result. It is the more desirable not to interfere in these cases, as the disease does not appear to shorten life.

Spontaneous aneurism of the carotid is not of very unfrequent occurrence; in Dr. Crisp's table of 551 aneurisms, 25 were of the carotid, and it ranks in order of frequency between those of the abdominal aorta and of the subclavian. It occurs more frequently in the female, than any other external aneurism: thus, of the 25 cases alluded to, 12 were in women; owing probably to it seldom being the result of violence, but generally arising from disease of the coats of the vessel. This aneurism is also remarkable as occurring at earlier ages than most others; thus, Hodgson has seen it in a girl of ten; and Sykes, of Philadelphia, in one of eighteen. The right carotid is much more commonly affected than the left, and the upper portion of the vessel than the lower; indeed, the bifurcation is the most common seat of aneurismal dilatation. The root of the right carotid not uncommonly is dilated, but I have never seen or heard of a case in which the left carotid, before emerging from the chest, has been affected.

A carotid aneurism, in the early stage, presents itself as a small, ovoid, smooth tumor, with distinct pulsation and bruit, and a well circumscribed outline. It is commonly soft and compressible, diminishing in size on pressure, and expanding again with the usual aneurismal dilatation. As it increases in size, it becomes more solid, occasions shooting pains in the head and neck, and by its pressure on the pharynx, œsophagus, and larynx, occasions difficulty in deglutition and respiration. Sometimes the salivary glands are much irritated. After a time, the cerebral circulation becomes interfered with, giving rise to giddiness, impaired vision of the corresponding eye, noises in the ear, and a tendency to stupor. These symptoms may each be owing to compression of the jugular, or to difficulty in the transmission of the blood through the tumor. The size that these aneurisms may attain varies greatly; usually they are confined to the space under the angle of the jaw, but not unfrequently they may occupy the greater part of the side of the neck. If allowed to increase uninterfered with, death may happen, either by the rupture of the sac externally, or into the pharynx, or œsophagus; by asphyxia, from pressure on the larynx or recurrent nerve; or by starvation, from compression of the œsophagus.

The diagnosis of carotid aneurism is without doubt more difficult than that of any other form of external aneurism; the best proof that this is so, may, I think, be found in the fact that out of 39 recorded cases in which the carotid artery has been ligatured for supposed aneurism of it or its branches, in 8 instances no such disease existed; solid cysts, or other tumors of the neck, having been mistaken for aneurism, and this by surgeons of great and acknowledged repute.

Fig. 189.



The diagnosis of aneurism of the lower part of the carotid from similar disease of other arteries at the root of the neck, as of the subclavian, vertebral, and brachio-cephalic, and the arch of the aorta, is surrounded by difficulties which can only be cleared up by a careful stethoscopic examination of the part. In some aneurisms of the arch of the aorta also, the sac rises up into the neck, so as closely to simulate a carotid aneurism, as in the annexed cut (fig. 189), and this greatly increases the difficulty of the diagnosis. The principal affections of the neck, however, with which aneurism

of the carotid may be confounded, are varix of the internal jugular, enlarged lymphatic glands, abscess, tumors, cysts in the neck, and pulsating bronchocele.

From varix the diagnosis may readily be made by attention to the following circumstances: — that in varix the tumor is always soft; does not pulsate expansively; diminishes in size during a deep inspiration, and on compressing the vein on its distal side.

Glandular tumors of the neck are often very difficult to distinguish from aneurism, more particularly when the artery passes through and is embraced by the tumor, so that the whole mass distinctly moves at each pulsation. In these cases also there may be an apparent diminution in the size of the tumor on compression, by the artery within it being emptied, or by the growth receding into some of the cellular interspaces of the neck. But in the great majority of instances, attention to the globular, oval, and nodulated feel of glandular swellings, the possibility of raising them up and pushing them away from the vessel, which may best be done by feeling the carotid with the ends of the fingers of one hand, and then pressing upon the tumor with the other, will clear up the true nature of the case.

From abscess of the neck the diagnosis must be made on general principles; the co-existence of ill-defined hardness and of enlargement of the glands, of an inflamed state of the skin, the ready detection of fluctuation, and the absence of expansive pulsation in the tumor, will show that it is not aneurismal, however similar its other characters may be. It is also of importance to observe that an aneurism that fluctuates is always forcibly distended with strong pulsation and can be materially diminished by pressure; neither of which circumstances can possibly occur in abscess. But if abscess may be mistaken for aneurism, the converse also holds good, and an aneurism may, unless care be taken, be mistaken for abscess; a far more fatal error. And there is one variety of false aneurism, that to which Mr. Liston has invited special attention, against which the surgeon must be carefully on his guard, on account of the many points of resemblance between it and aneurism; I mean the case in which an artery has given way into the sac of an abscess. In this case, fluctuation and pulsation will exist, though not perhaps of a distending kind. An important diagnostic mark will be, however, that the outline of an aneurism is distinctly defined and limited, while that of an abscess never is. Aneurism of the internal carotid has been found by Syme to simulate very closely abscess of the tonsils.

Tumors of various kinds, carcinomatous, fatty, and elastic, may occur in the neck, and cause some little embarrassment in the diagnosis from aneurism: thus Lisfranc, O'Reilly, and Kerr of Aberdeen, have recorded cases in which the artery has been ligatured in such cases by mistake for aneurism. The diagnosis of such tumors as these must be effected on ordinary principles. I have in several instances met with a small, hard, distinctly circumscribed tumor, lying directly upon the carotid artery and apparently connected with it, and receiving pulsation from it, usually produced by a fit of coughing or laughing. This tumor, with the true nature of which I am unacquainted, remains stationary, and does not require any operative interference.

The thyroid body is not unfrequently the seat of pathological changes, that have been and may be mistaken for aneurism. These consist chiefly in a limited, circumscribed enlargement of one of the lobes of the gland, which extends laterally over the common carotid, and receives pulsation from it. The most puzzling cases, however, and those in which mistakes may most easily be made, are instances of pulsating bronchocele, in which these tumors have an active and independent pulsation or thrill. In these instances, however, there are three points that will almost invariably enable the surgeon to effect the diagnosis. Thus, the tumor, although principally confined to one lateral lobe, always affects the isthmus more or less. Then again, in bronchocele, that portion of the tumor

is most firmly fixed which stretches towards the mesial line, whilst in carotid aneurism the firmest attachment is under the sterno-mastoid muscle. The third point of difference is, that on desiring the patient to make an effort at deglutition, the enlarged thyroid body moves with the pharynx and trachea, and being raised from the neighborhood of the vessels, the pulsation in it ceases, whilst no effect is produced on an aneurism. Cysts in the thyroid body are of more common occurrence than pulsating bronchoceles, and sometimes equally difficult of diagnosis. Dupuytren has pointed out that when these cysts are tapped, the pulsation often becomes stronger, and the fluid, which on first flowing is of a serous character, may at last become pure arterial blood, so that the surgeon may suspect that he has punctured an aneurismal tumor.

Aneurisms of the carotid are usually of slow growth, and may sometimes exist for a considerable number of years without giving rise to any special inconvenience; this is more particularly the case when they are seated at the bifurcation of the artery; when at the root, they are more likely to be attended by injurious pressure-effects.

Treatment. — Since the time that Sir A. Cooper first ligatured the carotid, in 1805, the only means on which the surgeon relies for the cure of aneurism of this vessel is, deligation of the artery at a distance from the sac. When the aneurism is so situated that a sufficient extent of healthy vessel exists between the sternum and the base of the tumor to admit of the application of a ligature, the Hunterian operation may be practised. If, however, the root or lower portion of the artery is so involved that there is no room to apply the ligature between the heart and the seat of the disease, the distal operation may be performed.

Ligature of the Carotid. — When the surgeon can choose the seat at which to ligature the artery, he usually selects that part of the vessel which bisects the angle formed by the anterior edge of the sterno-mastoid and the omo-hyoid muscles. The artery is reached by making an incision about three inches long over its course upon the anterior edge of the sterno-mastoid, which is the directing line, and a sure guide to the artery. After dividing the integument, the subcutaneous fascia, and cellular tissue, the sheath of the vessel is exposed. This must then be carefully opened, any branches of the descendens noni being avoided, and the ligature passed from without inwards, between the vein and artery. In performing this operation, subcutaneous vessels are occasionally wounded, which may bleed pretty freely; if so, they should be ligatured. When the sheath is opened, the jugular vein sometimes swells up considerably, so as to obscure the artery, but by being drawn aside with a retractor, or compressed by the assistant's finger, all difficulty from this source will cease. The pneumogastric is not seen, being drawn aside with the vein. If the aneurism have attained a very considerable size, extending low in the neck, and not leaving, perhaps, more than one inch of clear space above the clavicle for the surgeon to operate in, the difficulties are necessarily very greatly increased, and here the best plan will be to divide the tendon of the sterno-mastoid muscle, so as to give additional space. The external portions of the sterno-hyoid and sterno-thyroid muscles may likewise be cut across for the same purpose. The jugular vein in this situtation lies considerably to the outside of the artery.

After ligature of the carotid artery, the blood is so freely conveyed to the distal side of the vessel, by the free communication subsisting between the arteries of opposite sides within the cranium, that a continuance and return of pulsation in the sac is of common occurrence. This condition, however, usually disappears after a time by the gradual consolidation of the tumor, and indeed may generally be looked upon as a favorable sign, being very seldom associated with those cerebral symptoms that, as will immediately be explained, commonly prove fatal after this operation. It is interesting to observe that the collateral supply, after the ligature of the common carotid, is not afforded by any of the

branches of the corresponding vessel of the opposite side, but by the subclavian artery of the same side. In a case related by Porter, in which the right carotid had been tied, the subclavian and vertebral arteries on the same side were enlarged to at least double their natural diameters, and the chief communications outside the skull took place between the superior and inferior thyroid arteries, which were enlarged; whilst inside the cranium, the vertebral took the place of the internal carotid.

Suppuration of the sac is not of very uncommon occurrence after the ligature of the carotid for aneurism, sometimes even after so considerable an interval as eight months, as happened in a case related by Post. In the majority of these instances, the patient eventually does well, but death may result by the tumor pressing upon the pharynx and larynx, or by the occurrence of secondary hemorrhage, which may take place either from the part to which the ligature is applied, or from the suppurated sac. In the first instance it usually occurs about the period of the separation of the ligature, in the second it may happen at a considerably later period, even after many weeks. Besides these, which may be looked upon as the ordinary accidents following the application of a ligature for aneurism, deligation of the carotid artery occasionally gives rise to serious and even fatal disturbance of the circulation within the cranium.

Many experiments have been made by Meyer, Jobert, and others upon the lower animals, with the view of determining the effect produced on the brain by the ligature of the carotid arteries; but the deductions from these are of no value whatever when applied to the human subject, for the simple reason, which appears to have been strangely overlooked, that in many of the lower animals on which the observations were made, as the dog and rabbit for instance, the common carotid arteries are of secondary importance so far as the cerebral circulation is concerned, being destined principally for the supply of the external parts of the head, the brain deriving its chief supply from the vertebrals; whilst in other animals, as the horse, the brain derives nearly the whole of its blood from the carotids, and but a very small quantity from the vertebrals. Hence, in one case, the carotids may be ligatured without danger, whilst in the other their deligation is inevitably fatal. On turning to the result of observation on the human subject, we find, according to Dr. Norris, that the carotid artery has been ligatured in 149 instances, and that of these, 32 were fatal, 18 of the deaths resulting from cerebral disease. The proportionate frequency of deaths from this condition, according to the cause that led to ligature, may be seen by reference to the following table:—

TABLE OF LIGATURE OF CAROTID FOLLOWED BY FATAL CEREBRAL DISEASE.

CAUSE OF LIGATURE.	NUMBER OF CASES.	DEATH FROM CEREBRAL DISEASE.	DEATH FROM OTHER CAUSES.
Aneurism	38	7	5
Wound	30	6	2
Erectile and other tumors	42	3	5
Extirpation of tumors	18	1	1
Cerebral affections	6		
Distal operations	15	1	1
	149	18	14

By this it will be seen that the most common cause of death after the ligature of the carotid, is cerebral disease induced by the operation, as was, I believe, first pointed out by Dr. N. Chevers; and that this result appears to have followed the Hunterian more frequently than the distal operation. We should necessarily expect, that in those cases in which both vessels had been ligatured,

there would have been a greater tendency to cerebral disturbance than in those in which one only had been deligated. It would, however, appear, as is shown by the annexed table, that of the ten instances in which the double operation has been performed, death happened but in one case from this cause, and in another in which such disturbance took place, a fatal result did not occur.

CASES OF LIGATURE OF BOTH CAROTIDS.

OPERATOR.	AGE.	DISEASE.	DATES OF LIGATURE.	RESULT.
1. Preston.		Epilepsy.	Right carotid tied Aug. 23. Left carotid, Nov. 14.	Recovered.
2. Preston.		Epilepsy.	Tied at interval of month.	Recovered.
3. Macgill.		Fungous tumor of both orbits.		Recovered.
4. Mussey.	20.	Aneurism by anastomosis of scalp.	Left carotid, Sept. 20. Right carotid, Oct. 2.	Recovered.
5. Langenbeck.		Hemorrhage from superior thyroid.	Both at the same time.	Died next day.
6. Moller.	4½.	Erectile tumor.	Sept. 13, and Jan. 28.	Recovered.
7. Kuhl.	53.	Aneurism by anastomosis of scalp.	Left carotid first. Right forty-one days after.	Recovered; convulsions after each operation.
8. Mott.		Disease of parotid.	Interval of fifteen minutes.	Coma and death in a few hours.
9. Ellis.		Secondary hemorrhage following gunshot.	Interval of four and a half days.	Cured.
10. J. M. Warren.		Erectile tumor of face.	Tied left, October 5. Right, Nov. 7.	Cured.

After a careful examination of this subject, I think we are warranted in coming to the following conclusions:—1st. That the ligature of one carotid artery is followed in about one-fifth of the cases by cerebral disturbance, more than one-half of which are fatal. 2d. That when both carotids are ligatured *simultaneously*, death has hitherto always resulted, as in the two cases in which Mott and Langenbeck ligatured these vessels with an interval of but a few minutes between each operation. 3d. That when the two carotids are ligatured, *with an interval of some days or weeks*, the operation is not more frequently followed by cerebral disturbance than when only one is tied. 4th. Pathological investigation has shown that if the vessels be gradually and successively obliterated, the patient may live, although one carotid and one of the vertebral arteries have been occluded by disease and the other carotid ligatured, as in a case related by Rossi. And, lastly, as in a case recorded by Dr. Davy, an individual may even live for a considerable time, though both carotids and both vertebrals be occluded, the cerebral circulation being maintained through the medium of the anastomoses of the intercostals and internal mammary arteries.

The cerebral symptoms that arise from the ligature of one or both carotids may be such as depend upon a diminished supply of blood sent to the brain:

consisting of twitchings, tremblings, or convulsive movements, syncope, or giddiness, with paralysis, sometimes with complete hemiplegia of the side opposite to that of the ligatured vessel, troubled vision, and deafness; in other cases again, they appear to arise from increased pressure upon the brain, drowsiness, stupor, coma, and apoplexy supervening; and to the third order of symptoms belong those that are of an inflammatory character, usually coming on a few hours after the operation.

The cause of these symptoms is certainly the disturbance of the cerebral circulation, induced by the ligature of the carotid. When a considerable portion of the supply of blood to the brain is suddenly cut off, two sets of symptoms may ensue, one *immediate*, the other *remote*. The immediate symptoms are those that generally result from functional disturbance of the brain, consequent upon too small a supply of arterial blood. They consist of syncope, trembling, twitches, giddiness, impairment of sight, and at last hemiplegia. After this condition has been maintained for a few days, the nutrition of the organ becomes materially affected, and softening of the cerebral substance takes place, giving rise to a new and more serious set of symptoms, indicative of this pathological condition; such as convulsions, paralysis, and death. In other cases congestion may come on, either by the interference with the return of blood through the jugular vein, or as a consequence of that venous turgidity that we so commonly observe after the ligature of a main arterial trunk, or perhaps as the result of apoplectic effusion into a softened portion of the organ inducing coma.

Inflammation of the brain may come on immediately after the application of the ligature, being apparently at once induced by the disturbance of the circulation. In other cases it occurs at a later period, as the result of alteration in the structure of the organ.

Besides the brain, it not uncommonly happens that the lungs are secondarily affected after ligature of the carotid. To this condition special attention has been directed by Jobert and Professor Miller. The lungs appear to become greatly congested, and have a tendency to run into a low form of inflammation. The cause of this congestive condition of the lungs is extremely interesting. It cannot be owing to the simple obstruction of the passage of the blood through the carotid, causing a disturbance in the balance of the circulation, and thus a tendency to internal congestion; for if this were the cause, we ought to meet with it generally after the ligature of the arteries of the first class. Nor can it be owing to any injury sustained by the eighth nerve during the deligation of the artery; as in many of the instances in which it is stated to have occurred, there was no evidence of that nerve having been exposed or damaged, and every reason to believe the contrary, from the known skill of the operators. I am rather inclined to look upon the unusually frequent occurrence of pulmonic congestions after ligature of the carotid, as the secondary condition consequent upon a derangement in the functions of the brain and medulla oblongata, primarily induced by the disturbed state of the circulation through that organ. For we know that any cause that depresses the activity of the nervous centres tends to diminish proportionately the freedom of the respiratory movements, and thus, by interfering with the due performance of the act of respiration, disposes to congestion of the lungs, just as we observe happens in injuries of the head in apoplexy, and in the operation of the sedative poisons. It would appear from the detail of some of the recorded cases, as well as from Jobert's experiments, that blood-letting is of considerable service in the removal of this condition, and should consequently not be omitted.

Ligature of the carotid on the distal side of the sac.— Aneurism of the carotid artery, occurring low in the neck, does not admit of the application of a ligature on the cardiac side of the tumor. What, then, is to be done in such a case as this? — should it be left to the remote chance of a spontaneous cure, or should it be subjected to surgical interference? The occurrence of spontaneous

cure in carotid aneurism has never yet, I believe, been met with. The surgeon, therefore, must endeavor to treat the disease by ligature. In this way two plans of treatment are open to him — either to deligate the innominata, or to tie the carotid on the distal side of the tumor. The first alternative may fairly be set aside, for not only are the cases in which it is possible to find room between the sternum and the sac extremely rare, but even were such an instance to present itself, no surgeon would, I think, be justified in undertaking an operation which has never yet succeeded in the most skilful hands; we are consequently reduced to the alternative of ligaturing the artery on the distal side of the sac. But although this operation is the only alternative that presents itself, yet its application in practice is attended by serious difficulties and perplexities; for the surgeon must be able to satisfy himself that it is actually an aneurism of the root of the carotid with which he has to do, and that it is not the trunk of the innominata or the arch of the aorta that is affected. The difficulty in doing this is far greater than would at first appear; for, on examining the details of 8 cases in which the distal operation has been performed for supposed carotid aneurism, 3 must be excluded; as, after death, the tumor was found to arise from the aortic arch. In the annexed table will be found the result of 5 cases, in which the carotid artery has been tied for aneurism of its root on the distal side of the sac. I have excluded a 6th case, as there is reason to believe that in it the artery was not ligatured, but a portion of the sheath accidentally tied instead — an accident by the way, that Sedillot has seen happen, and which Norris relates also to have occurred at the New York Hospital; and which I have known happen to a most excellent surgeon in the case of ligature of the femoral.

ANEURISMS OF ROOT ON CAROTID TREATED BY LIGATURE ON DISTAL SIDE.

OPERATOR.	SEX.	AGE.	RESULT.	CAUSE OF DEATH.	REMARKS.
1. Wardrop.	f.	63.	Recovered.		Tumor diminished until fifth day, then inflamed, suppurated, and burst. The patient recovered, and was alive three years after operation.
2. Lambert.	f.	49.	Successful so far as aneurism was concerned.	Hemorrhage from upper portion of artery.	Tumor diminished after operation, and became consolidated; sac filled with firm coagulum, and lower part of artery closed; ulceration into artery, just above part ligatured; dilated where ligatured.
3. Bush.	f.	86.	Recovered.		Suffocation was imminent before operation; tumor became rapidly diminished after ligature. Alive three years afterwards.
4. Colton de Noyou.	f.	63.	Recovered.		Tumor and pulsation diminished. Alive and well three years after.
5. Lane.	m.	36.	Died 68th day.	Inflammation of lungs.	Tumor filled with layers of coagulum. Ulcerated opening communicating with apex of left lung.

On analyzing the 5 cases in which the trunk of the common carotid has been ligatured on the distal side of an aneurism of the root of that vessel, there are several points of interest that arrest our attention; thus we find that in every

case the tumor, immediately on the ligature being tightened, underwent a considerable diminution in its bulk with corrugation of the integuments covering it, and considerable subsidence in the force of its pulsations. In one case, that of Mr. Bush, respiration, which before the operation had been attended with great difficulty, became easy; and in another, that of Mr. Wardrop, inflammation of the sac, unattended however by any bad consequences, took place. It is not safe to deduce any general conclusions from so small a number of cases. But yet the result of these is so uniform that I have no hesitation in stating it as my opinion, that whether we regard the principle on which this operation is founded, the amount of success that has hitherto attended it, the necessary fatal result of these cases if left to themselves, or the absence of any other means that hold out a reasonable hope of benefit, the surgeon is justified in resorting to the ligature of the trunk of the common carotid on the distal side of the sac, in cases of aneurism, limited to the root of that vessel.

ANEURISM OF INTERNAL CAROTID AND ITS BRANCHES.—The internal carotid artery may be the subject of aneurism before or after it has passed through the carotid canal and entered the cranium. The symptoms of these two classes of cases differ necessarily in almost every respect, as likewise do the termination and the susceptibility of the case to surgical interference.

When an aneurism affects the trunk of the internal carotid before its entrance into the cranium, the symptoms presented by this disease do not materially differ from those of aneurism at the bifurcation, or of the upper part of the common carotid, except in one important respect, which was I believe first pointed out by Mr. Porter, of Dublin—viz., tendency to the extension of the tumor inwards towards the pharynx, and to its protrusion into that cavity. The reason of this is obvious; when we consider the anatomical relations of the internal carotid artery, we at once see that its pharyngeal aspect is that which, if one may so term it, is the most superficial, between which and the surface the smallest amount of soft part intervenes — nothing lying between the vessel and the mucous membrane except the thin, paper-like constrictor, some lax cellular tissue, and a few filaments of the superior laryngeal nerve; whilst externally there is interposed between it and the integument, the layers of the cervical fascia, the margin of the sterno-mastoid, the digastric and three styloid muscles, and the styloid process.

When dilatation, therefore, of the vessel takes place, it has a necessary tendency to push forwards that part of its covering where it meets with least resistance, and this being to the pharyngeal side, more or less prominence will consequently be found in this cavity. In a case that occurred to Mr. Syme, this was especially well marked, the aneurism of the internal carotid simulating closely an abscess of the tonsil. In two cases related by Mr. Porter, in the 17th volume of the "Dublin Journal," this was one of the most marked features, the "appearances of the tumor (as seen by the mouth) were most alarming; the pulsation could be distinctly seen, and the blood almost felt under the mucous membrane; it seemed ready to give way, and burst into the mouth every moment."

The treatment of these cases does not differ from that of aneurisms connected with the carotid arteries, and seated at the upper part of the neck; but we are not in possession of a sufficient number of facts to enable us to determine with any degree of precision what the result of surgical interference in them is likely to be. If we could give an opinion from the limited number of cases at present before the profession, we should feel disposed not to entertain a very favourable opinion of the result of the Hunterian operation, as applied to these cases. This is doubtless owing to the situation of the aneurism against the mucous membrane of the mouth, being such that the surrounding tissues do not exercise a sufficient amount of pressure against the sac after the ligature of the vessel to allow of the efficient deposition of lamellated coagulum, and consequent occlu-

sion of the artery leading into it, which, in accordance with the principles that have been laid down in speaking of the Hunterian operation, is necessary.

After the carotid artery has passed through the carotid canal, and has entered the cavity of the cranium, it or its branches may occasionally be the subject of aneurism; but as the consideration of these *intracranial* aneurisms does not fall within the province of the surgeon, it need not detain us.

ANEURISM OF THE SUBCLAVIAN ARTERY.

Aneurisms of the subclavian occur in order of frequency between those of the carotid and of the brachio-cephalic. They are most frequently met with on the right side, in the proportion of nearly three to one, and this would appear to be in a great measure dependent on their being occasioned by direct violence, or of repeated and prolonged exertion of the arm; thus they commonly occur from falls, blows upon the shoulder, or excessive fatigue of this extremity. From the fact of the aneurisms arising from external violence, we should expect to meet with them most frequently in males, and this we do in a remarkable manner. Of 32 cases, I find only 2 occurring in females, and in both these instances the disease resulted from injury. The disease may be seated in any part of the vessel on the right side, though most commonly it is not dilated until after it has got beyond the scaleni. On the left side it never occurs before its emergence from the thorax, and then, as on the right, aneurism most commonly happens in the third part of the course of the vessel.

An aneurism of the subclavian artery is characterized by a pulsating compressible tumor of an elongated or ovoid shape, situated at the base of the posterior inferior triangle of the neck, immediately above the clavicle. If it be small, it will disappear behind this bone on the shoulder being raised; as it increases in size, it fills up the whole of the space between the clavicle and the trapezius, often attaining a very considerable bulk. In consequence of the pressure which it exercises on the brachial plexus of nerves, there is pain, often attended by numbness, and extending down the arm and fingers, usually with some weakness of these parts. In some instances there is a spasmodic affection of the diaphragm, owing to irritation of the phrenic nerve. The external jugular vein is commonly distended and varicose, with œdema of the hand and arm, or even of the side of the body. The tumor does not increase rapidly in size, owing to its being tightly compressed by the surrounding parts, and as the disease never extends inwards, it does not interfere with the trachea or œsophagus. In some cases it has been known to extend downwards and backwards, so as to implicate the pleura and the summit of the lung.

The *diagnosis* of these aneurisms is usually easy, and presents no point of a special character. As they increase in size they may become diffused, and burst either externally or into the pleural sac. In some instances a spontaneous cure has been observed.

The *treatment of subclavian aneurism* is in the highest degree unsatisfactory. The attempt at obtaining consolidation of the tumor by constitutional means, by galvano-puncture, or compression, have hitherto failed, except in some very rare instances. A case is reported by Mr. Yeatman of the cure of subclavian aneurism by Valsalva's plan in eighteen months; and another by Dr. Abeille, in which the tumor was consolidated by galvano-puncture. *Manipulation*, as recommended by Mr. Fergusson, has succeeded in the hands of Mr. Little, and undoubtedly deserves a trial in these cases, when we consider the extreme danger and almost universal want of success that attends other means of cure.

The ligature of the brachio-cephalic, and of the subclavian itself, before, between, and beyond the scaleni muscles, has been practised for the cure of this form of aneurism; it has likewise been proposed to apply the distal operation to the treatment of this disease, and to amputate at the shoulder-joint.

When an aneurism is situated on the right subclavian artery on the tracheal side of the scaleni, there is no way in which the flow of blood through it can be arrested, except by the ligature of the brachio-cephalic artery. When it is situated beyond the scaleni, or even between these muscles, the ligature of the vessel has been practised in the first part of its course before it reaches these muscles. For subclavian aneurisms on the left side, in these situations, no operation conducted on the Hunterian principle would be practicable.

CASES OF LIGATURE OF BRACHIO-CEPHALIC.

OPERATOR.	AGE AND SEX.	NATURE OF DISEASE.	RESULT.	REMARKS.
1. MOTT.	m. 57.	Subclavian aneurism.	Died on 26th day.	Tied an inch below bifurcation. Ligature separated in fourteen days. Hemorrhage in twenty-five, stopped by pressure. Recurred in twenty-six.
2. GRAEFE.		Subclavian aneurism.	Died on 67th day.	Ligature separated in fourteen days. Died of hemorrhage.
3. HALL.		Subclavian aneurism.	Died on 5th day.	Coats of artery were diseased and gave way. Wound plugged without success.
4. DUPUYTREN.			Died.	Case referred to as occurring in the practice of Dupuytren.
5. NORMAN.			Died.	
6. BLAND.	m. 31.	Subclavian aneurism.	Died on 18th day.	Hemorrhage came on on the seventeenth and eighteenth days. Ligature applied to upper portion of artery.
7. LIZARS.		Subclavian aneurism.	Died on 21st day.	Ligature separated on seventeenth day. Hemorrhage on nineteenth.
8. HUTIN.	m. 26.	Hemorrhage from axilla after ligature of subclavian.	Died in 12 hours.	Punctured wound in axilla, for which subclavian was tied; secondary hemorrhage, and then b. c. ligatured.
9. ARENDT.		Subclavian aneurism.	Died on 8th day.	Inflammation of lung, pleura, and aneurismal sac.

N. B.—The artery was cut down upon, but not ligatured, by Porter, Post, Aston Key, and Hoffman.

LIGATURE OF THE BRACHIO-CEPHALIC.—Let us now proceed to examine the results that have attended these operative procedures. The brachio-cephalic artery, as may be seen by the accompanying table, has been ligatured 9 times, and in every instance with a fatal result. In 4 other instances, the operation has been commenced, but abandoned owing to unforseen difficulties, and this by three of the most skilful operators that their respective countries can boast of. Although in reasoning on the propriety of performing an operation, it is not in general worth while taking the difficulties that a surgeon may encounter into consideration, provided the operation be at last practicable; yet, when we consider the fact of the ligature of the brachio-cephalic having been attempted, and in consequence of unforeseen and insurmountable difficulties left unconcluded in so large a proportion as one-fourth of the cases, and these in the hands of surgeons who were as well able as any to accomplish whatever was in the power of operative surgery to do, we may well hesitate upon the difficulties that beset the operation itself, before proceeding to the consideration of its results. The difficulties to which I allude, do not consist merely in the position and anatomical relations of the vessel, but rather in the condition in which the artery and

adjacent structures may be found after the vessel is exposed. Thus, in Mr. Porter's case, the aneurism, which was a large one, occupied the whole of the posterior inferior triangle of the neck, being nearly six inches broad; as no pulsation was traceable in the vessels beyond the aneurism, it was useless to attempt the ligature on the distal side. On exposing the brachio-cephalic, that vessel was found to be diseased, and it was not thought desirable to pass the ligature round it. In consequence of the exposure of the artery, however, the pulsation in the tumor gradually diminished, and at last ceased entirely, its bulk also becoming less.

In Mr. Key's case, in which it was impracticable to pass the ligature, it was found after death that the brachio-cephalic was diseased, being dilated immediately after its origin into an oblong tumor, which occupied the whole of the artery. It is remarkable that in this case, as in Mr. Porter's, inflammation seems to have taken place in the artery in consequence of the necessary handling to which it was subjected, and that the pulsation in the sac consequently diminished.

It would thus appear, that even after the difficulties of the operation have been surmounted, (and these, from the depth of the vessel, its proximity to the centre of the circulation, the neighborhood of large veins, which may become turgid, and a wound of which not only obscures the line of incision with venous blood, but induces a risk of the entrance of air into the circulation, are of serious magnitude,) and the artery has been exposed, its coats may be found so diseased, or its calibre so increased, that it may be undesirable or impossible to pass a ligature round it. The failure in deligating the artery would, however, as we shall immediately see, appear to be less disastrous in its consequences than success in that attempt; for of the 3 cases that have just been referred to, in which this attempt was made and did not succeed, 1 was cured of the disease, the artery being obliterated by adhesive inflammation; and in another, Mr. Key's patient, an attempt to set up this action appears to have been made, the tumor becoming solid and ceasing to pulsate, whereas in every case in which the vessel was ligatured, a fatal result speedily ensued.

The results of the ligature of the vessel are in the highest degree discouraging; for of the 9 cases in which it has been done, not one recovered. Death occurred from secondary hemorrhage in 4 cases, from inflammation of lungs or pleura in 2, and in 3 from causes that are not mentioned.

In one case, that of Hall, the artery was transfixed by the aneurism needle; hemorrhage occurred at the time, which was arrested by plugging, and did not recur, the patient dying from other causes. In 3 cases, those of Mott, Bland, and Lizars, the hemorrhage came on shortly after the separation of the ligature; but in Graefe's (the most successful) it did not occur for fifty-one days after this, the cicatrix in the artery having then probably given way under the influence of some imprudent movement on the part of the patient. With such results as these, there can, I think, be but one opinion as to the propriety of such an operation being again had recourse to. As its performance has hitherto in every instance entailed death, and, in all cases but one, a speedy death to the patient, it should without doubt be banished from surgical practice; and I can think of no circumstances that should induce a surgeon, in the face of the consequences that have hitherto invariably followed the application of a ligature to this artery, again having recourse to such a procedure.

Ligature of the subclavian.—If the aneurism be situated on the right subclavian artery, between or beyond the scaleni, that vessel has been ligatured on the tracheal side of these muscles; on the left side this operation is not practicable, on account of the depth at which the artery is situated. When we consider the anatomical relations of that portion of the right subclavian, which intervenes between the brachio-cephalic artery and the tracheal edge of the scalenus anticus muscle, we are at once struck with the great difficulties of this

undertaking; and when we reflect on the position in which the ligature will be placed between the onward current of blood in the brachio-cephalic on the one side, and the regurgitant stream conveyed by the vertebral, the thyroid axis, the internal mammary and intercostal, into the subclavian, immediately beyond the seat of deligation on the other side, we could scarcely, in accordance with those principles on which the formation of a coagulum within a ligatured vessel takes place, anticipate any but the most disastrous results.

In reference to the mere difficulties of the operation, Mr. Fergusson justly characterizes it as the most serious in surgery; the proximity of the common carotid artery on one side, the internal jugular vein on the other, the vena innominata below, the par vagum and numerous small venous trunks in front, the recurrent laryngeal nerve and pleura behind, constitute relations of sufficient importance to justify Mr. Fergusson's opinion. But supposing these difficulties overcome, and the ligature applied, this must be situated, as has just been stated, in such a position, with a strong current of blood flowing upon either side of it, as to render the formation of an internal coagulum, and consequently occlusion of the artery, impossible, and thus to lead inevitably to the occurrence of a fatal hemorrhage on the separation of the ligature. Besides the danger of secondary hemorrhage from these causes, there would be the additional risk of the coats of the artery being diseased, as we commonly find them in a more or less morbid state in the immediate vicinity of aneurisms; and thus being rendered insusceptible of healthy inflammation, ulceration and sloughing would take place along the track of the ligature, thus causing the probability of a recurrence of hemorrhage. Thus, in Colles's case, it was found on exposing the subclavian artery, that the aneurism had extended in such a way towards the carotid, that it was doubtful whether any part of the affected vessel continued sound. On exposing it fully, it was found that only a space of the vessel three lines in length remained free between the sac and the bifurcation of the brachio-cephalic, and it was in this narrow space that the ligature was applied.

The subclavian has been ligatured on the tracheal side of the scaleni muscles in 7 cases, all of which have proved fatal, 6 from hemorrhage, and 1 from inflammation of the pericardium and pleura.

The cases are as follow:—

SURGEON.	SEX.	AGE.	DATE OF DEATH.	CAUSE OF DEATH.
Colles.	m.	33.	4th day.	Hemorrhage.
Mott.	f.	21.	18th day.	Hemorrhage.
Hayden.	f.	57.	12th day.	Hemorrhage.
O'Reilly.	m.	39.	13th day.	Hemorrhage.
Partridge.	m.	38.	4th day.	Pericarditis and pleurisy.
Liston.[1]	m.		13th day.	Hemorrhage.
Liston.[2]	m.		36th day.	Hemorrhage.

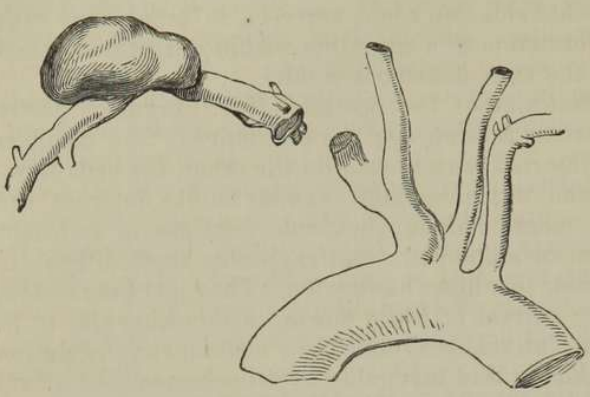
Thus it will be seen, that if this operation is bad in principle it is most unfortunate in practice. This table is, to my mind, conclusive as to the merits of the operation, the patient having in every case but one been carried off by secondary hemorrhage from the distal side of the ligature, in consequence of the close proximity of numerous collateral branches (fig. 190), and in this exceptional case the operation, although performed with the utmost delicacy and skill, proving fatal from pericarditis and pleurisy before the period at which secondary hemorrhage might have been expected. Mr. Liston, in one case, ligatured the root of the common carotid, as well as that of the subclavian,

[1] In this case the carotid was also tied, but the hemorrhage came from the subclavian (fig. 191).

[2] Fig. 190.

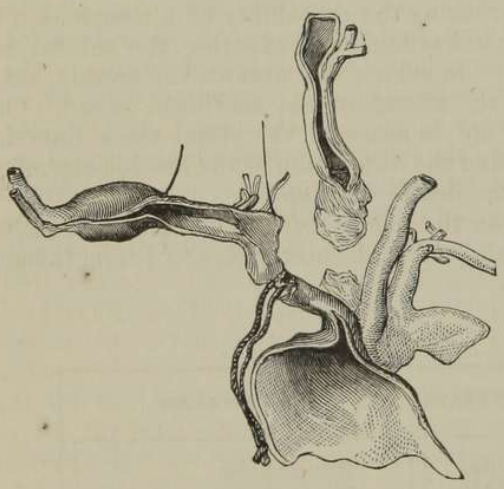
hoping in this way to diminish the risk of the supervention of this fatal hemorrhage, by arresting the current of blood which, by sweeping into the carotid past the mouth of the subclavian, necessarily washed away any coagulum that would otherwise have formed in this artery. But his expectations were not realized, hemorrhage taking place as usual, and from that portion of the artery which lay on the distal side of the ligature (fig. 191), the blood having been carried into this part of the vessel in a retrograde course, through the connection existing between its vessels arising from it at this point, and those on the opposite side of the head and neck, as illustrated by the annexed cut, taken from the preparation of the case in the University College Museum.

Fig. 190.



Indeed this is the great danger to be apprehended after ligature of the subclavian artery on the tracheal side of the scaleni, depending as it does on the anatomical relations and connections of the vessel, which no skill on the part of the operator can in any way lessen, and which, in my opinion, ought certainly to cause this operation to be banished from surgical practice.

Fig. 191.



When an aneurism is situated on the subclavian artery, in the posterior inferior triangle of the neck, it is necessarily impossible to ligature that vessel beyond the scaleni, as there would not be sufficient room for the exposure of the artery, which, even if laid bare would in all probability be found in too diseased a condition to bear the application of a ligature.

Thus it will be seen, that in every case in which an aneurism of the subclavian artery has been subjected to operation, whether by ligature of the brachio-cephalic or of the subclavian itself *internul* to the scaleni, the result has been a fatal one. As this unfortunate termination to every case that has yet been submitted to surgical interference is in no way to be attributed to want of skill on the part of the operators, who are, without exception, men greatly distinguished for the possession of this very quality, but is solely dependent on certain anatomical peculiarities in the arrangement of these vessels, by which their successful ligature has been rendered impossible, a repetition of these attempts, which may hasten the patient's death, can scarcely be considered justifiable. What then are we to do? Are we to leave patients laboring under aneurism of the subclavian artery to inevitable death, without making an effort to save them? or does surgery offer other modes of treatment besides those just mentioned, by which we may hope to arrive at more successful results?

Without mentioning manipulation, or galvano-puncture, which is certainly

deserving of further trials in combination with appropriate constitutional treatment, three modes of treatment present themselves: —

1st. Compression on the artery where it passes over the first rib, and consequently on the distal side of the tumor.

2d. Ligature of it on the distal side, above or below the clavicle.

3d. Amputation at the shoulder-joint, and the distal ligature of artery.

1st. Compression of the artery on the distal side of the sac could only be effected where it crosses the first rib, and consequently would only be applicable to aneurisms of the first part of this vessel. This plan has never been tried, partly, perhaps, on account of the difficulty in applying pressure in this situation, and partly, probably, on account of the want of success that has attended procedures of this kind when applied to vessels in other situations.

The difficulty in applying the compression might, I think, be overcome by the use of the instrument of which a representation is given by Bourgery; and the efficiency of the compression would be materially increased by the employment of the galvano-puncture at the same time, and in this way a coagulum might be formed in the sac. Although much ought not to be expected from this mode of treatment, yet I think it might with propriety be tried in cases of this kind that have been mentioned.

2d. Dupuytren ligatured the axillary artery under the pectoral muscles, for a case of subclavian aneurism, two arterial branches being divided in the incisions through the fat and cellular tissue, and the patient died on the ninth day. This is the only instance, to my knowledge, in which the distal operation has been attempted for the cure of this disease. It could not be expected to succeed; for between the ligature and the sac are the large and numerous alar, acromial, and thoracic branches of the axillary artery, which would continue to be fed by a current sent through the tumor, and thus preclude the possibility of its contents being sufficiently stationary for ultimate contraction and cure to result. Laugier performed the distal operation in a supposed case of subclavian aneurism, which afterwards turned out to be one of the brachio-cephalic artery.

Ligature of the subclavian artery in the third part of its course, on the distal side of the tumor has been suggested, and may, perhaps, hold out some prospect of success in cases of aneurism situated between or internal to the scaleni. In an aneurismal sac springing from the artery in this situation, the principal current of blood would, in all probability, be that which is destined for the supply of the upper extremity. Some of the branches arising from the artery before it has passed beyond the scalenus anticus would, doubtless, be more or less compressed, and thus obliterated, by the tumor, or might be obstructed by an extension of the laminated fibrine over their orifices. If, therefore, the supply to the upper extremity could be cut off, there might be a possibility of those changes taking place within the sac which are necessary for the obliteration of its cavity. The principal obstacles to this desirable result would necessarily be the transversalis colli and humeri arteries; which, being the two vessels that are more particularly destined to carry on the circulation in the upper extremity after the ligature of the subclavian, would necessarily, if not occluded, undergo dilatation, and thus continue to draw too large a current of blood through the sac for stratification of its contents to take place; and if occluded, there would be danger of gangrene of the arm from insufficient vascular supply. These difficulties are met by a plan of procedure, the suggestion of which has originated, I believe, with Mr. Fergusson, but which has not, to my knowledge, been had recourse to as yet. It is, 3d, the amputation of the arm at the shoulder-joint, and then the distal ligature of the artery — a desperate undertaking truly, but for a desperate disease it must be remembered, and one that has never yet, under ordinary surgical treatment, been cured.

The artery might be ligatured before the amputation. "It is known," says

Mr. Fergusson, "that amputation at the shoulder-joint is generally a very successful operation; so far as this wound is concerned, then, there might be little to apprehend, but the effect on the tumor is not so easily foretold. Ligature of the axillary artery on the face of the stump might here be reckoned like Brasdor's operation, — yet there is a vast difference, for in the latter case the same amount of blood which previously passed towards the upper extremity, would still find its way down, and probably part of it would run through the sac; whereas, were the member removed, as the same quantity would no longer be required in this direction, the tumor might possibly be much more under the control of pressure. The value of such a suggestion remains yet to be tested, however, and it would be futile to reason upon it at present. It might be a judicious venture first to tie the axillary or subclavian under the clavicle, and then, if it were found that the aneurism still increased, amputation might be performed, either immediately before or after the separation of the ligature."

Were a case of aneurism of the subclavian artery internal to the scaleni, to present itself to me, the plan that I should adopt would be, first the employment of pressure on the vessel on the distal side of the tumor, if practicable; should this not succeed, I would, if the disease were situated between, or internal to the scaleni, ligature the artery in the third part of its course, and did that not succeed in checking the increase of the aneurism, perform amputation at the shoulder-joint as recommended by Mr. Fergusson. Should the aneurism occupy the artery after it has passed the scaleni, I would not attempt the ligature of the artery below the clavicle, as it is an operation, the result of which is not very satisfactory, and would not prevent a large current through the sac for the supply of the collateral circulation of the arm, but at once have recourse to amputation at the shoulder, and then ligature the vessel, as near as possible to the sac. It is true that even in this case the ligature would be below the branches that are given off under the pectoral muscles, but as the arm would be removed, they could not undergo any increase of activity for the supply of the collateral circulation of the upper extremity.

ANEURISM OF THE AXILLARY ARTERY.

This artery, though less commonly the seat of aneurism than other large vessels, such as those of the ham, the groin, and the neck, yet is sufficiently frequently diseased, owing partly to its situation; for its proximity to the shoulder-joint causes it to be subjected to the very varied, extensive and often forcible movements, of which that articulation is the seat; and partly to the artery being deficient in that support which would be afforded it by an investing sheath, such as is commonly met with in arteries of corresponding magnitude. Amongst the most frequent causes of axillary aneurism, may be mentioned falls upon the shoulder or upon the outstretched hands, and in many cases the efforts made at reducing old standing dislocations; instances of which are recorded by Pelletan, Flaubert, Warren, and Gibson; the head of the bone in these cases having probably contracted adhesions to the artery, in consequence of which the vessel was torn during the efforts at reduction. Axillary, like subclavian aneurism, occurs more commonly on the right than on the left side, and is met with in especial frequency amongst men; of 37 cases, only 3 have occurred in women.

In axillary aneurism there are three sets of symptoms, attention to which will usually enable the surgeon to recognize the disease; these are, the existence of a tumor in the axilla, the pain that it occasions, and the affections that it gives rise to in the limb.

The precise situation at which an aneurism of the axillary artery presents externally, will depend upon whether it springs from that portion of the vessel

that lies above, beneath, or below the pectoralis minor muscle. If from above, it will appear as a tumor seated immediately below the clavicle and occupying the triangular space between the upper margin of the lesser pectoral and that bone; if it be lower down, it will raise the anterior fold of the axilla, being prevented extending much out of this space, by the dense fascia that stretches across from one side to the other. The tumor, which is at first soft and compressible, has a whizzing bruit, and its pulsations, which are expansile, may be arrested by pressure upon the subclavian artery, where it passes over the first rib. It usually increases with great rapidity, owing to the little resistance opposed by the loose cellular tissue in this situation, and most commonly extends downwards and forwards, causing the hollow of the axilla to disappear. In some rare instances, however, the tumor has been known to take a direction upwards under the lesser pectoral, and into the cellular interval above that muscle, or even underneath the clavicle into the acromial angle between it and the trapezius. Such a course for the aneurism to take is fortunately rare, as it presents serious inconvenience in the ligature of the subclavian, and there is more than one instance on record in which the sac has been punctured in the attempt to pass the needle round this vessel. When the aneurism is seated high up, it not unfrequently happens that the clavicle is pushed upwards by the pressure of the tumor beneath it — a complication of considerable moment in reference to the operation, the difficulties of which are greatly increased by it. The pressure of the tumor may give rise to serious consequences upon neighboring parts; thus, it may occasion a carious state of the first and second ribs, and the compression of the brachial plexus of nerves will occasion pain and numbness in the upper extremity. In some cases the brachial artery beyond the tumor would appear to be obstructed, no pulsation being perceptible in it; and the compression of the axillary vein may occasion œdema of the hand and arm, with some diminution in the temperature of the limb, which, if the tumor attain a very large size, may even amount to symptoms indicative of impending gangrene.

The *diagnosis* of axillary aneurism is usually readily made; there being but two diseases with which it can well be confounded, viz. chronic enlargement and suppuration in the glands of the axilla, and pulsating tumor of the bones in this region. From glandular or other abscess, the diagnosis is generally easy; but I have seen some cases in which, pulsation being communicated to their contents by the subjacent artery, it was somewhat difficult to distinguish the nature of the tumor. Here, however, the history of the case and its speedy progress to pointing will indicate its true nature. From medullary tumor, or osteo-aneurism of the head of the humerus, the diagnosis is not always so easy, and there are at least two instances on record in which the subclavian artery has been ligatured for disease of this kind, on the supposition of its being an aneurism. In these instances it has, however, generally been observed that the tumor first made its appearance on the forepart of the shoulder, and not in the usual situation of axillary aneurism; that it was from the first firm, smooth, elastic, but nearly incompressible; and that although it presented distinct pulsation, there was no true bellows sound, but rather a thrilling bruit perceptible in it. The most important diagnostic mark, perhaps, is the fact of these tumors forming a prominence in situations in which aneurisms of the axillary artery would not at first show themselves, as at the upper, outer, or anterior part of the shoulder. In more advanced stages, when the substance of the bone has undergone absorption, and its shell has become thin and expanded by the outward pressure of the tumor, there is often a dry, crackling, or rustling sound perceived on pressure, which is never met with in cases of aneurism.

Treatment of axillary aneurism.— I am not acquainted with any instance in which an aneurism of the axillary artery, not arising from wound or injury, has undergone spontaneous cure, or been consolidated by constitutional treat-

ment. Nor is it probable that compression can ever be made applicable to aneurisms in this situation, inasmuch as the pressure that is brought to bear upon the subclavian must necessarily at the same time influence the whole or the greater part of the brachial plexus of nerves, to such an extent as to be unendurable by the patient. The ligature of the artery is, therefore, the surgeon's sole resource in the treatment of these cases. The part of the vessel universally selected for the application of the ligature is, in accordance with the Hunterian doctrines, that which lies on the first rib beyond the scalenus anticus muscle; this part presenting the advantage of being sufficiently removed from the seat of disease to insure the probability of the coats of the artery being in a sound state, of being by far the most accessible, and, when deligated, of allowing the collateral circulation by which the vitality of the arm is to be maintained, to remain uninjured. Notwithstanding these obvious advantages presented by the ligature of the subclavian over that of the axillary artery — in other words, of performing Hunter's instead of Anel's operation for the cure of spontaneous axillary aneurism — there would appear to be a tendency in the minds of some surgeons, to advocate the latter instead of the former of these operations; and to substitute for one that offers the advantages that have just been mentioned, a procedure that is not only much more difficult in its performance, and that interferes with the collateral circulation, but that is practised upon a diseased part of the vessel, in dangerous proximity to the sac.

Ligature of subclavian in third part of its course. — In order to apply a ligature to that portion of the subclavian artery which intervenes between the acromial edge of the scalenus anticus and the lower border of the first rib, the patient should be placed in a recumbent position, the arm depressed as much as possible, and the head turned somewhat to the opposite side. The integuments of the lower part of the neck should then be put on the stretch by being drawn downwards over the clavicle, and an incision about four inches in length made upon the bone through the integument, the superficial fascia, and the platysma. When tension is taken off the part, this incision will be found to traverse the base of the inferior triangle of the neck; a vertical incision should then be made at right angles to and falling into the centre of the first, and the two flaps of integument and fascia should then be turned up. A quantity of loose cellular tissue will now be exposed, in which a venous plexus, and the lower end of the external jugular vein, will commonly be found. These vessels should be carefully avoided, and the cellular tissue dissected or scratched through with the point of a knife and a blunt probe; should any vein be wounded, a double ligature must be passed underneath it, or either end tied. If the transversalis colli or humeri arteries, as occasionally happens, should inconveniently traverse this place, they must be drawn out of the way with a blunt hook. By the combined action of cutting and scratching through the cellular tissue, the external edge of the scalenus anticus is reached; this is the "directing line" down which the finger is run until the tubercle of the first rib is felt. This is the guide to the artery, which will be found immediately above and a little behind it, covered, however, and bound down to the rib by a dense fascia. This must now be very carefully opened with the edge of the knife, and the needle passed from before backwards. In doing this, attention must be paid to the brachial plexus, situated above and behind the artery.

There are several points in connection with this operation that deserve special attention. In the first place it is necessary that the shoulder should be depressed as far as possible, so as to bring the superior margin of the clavicle down. This is a matter of much importance; for if the clavicle be thrust upwards by the pressure of a large aneurism, the surgeon will have to find the artery at the bottom of a deep narrow wound, instead of on a comparatively plane surface. A case occurred to Sir A. Cooper, in which the attempt to ligature the subclavian artery for a large aneurism of the axilla was forced to be abandoned, in conse-

quence of the clavicle being thrust up to too great a height to enable him to reach the vessel. The extent of the difficulty occasioned by this elevation of the clavicle must necessarily depend in a great measure upon the height at which the subclavian artery happens in any particular case to be situated in the neck. It is not uncommon to find it pulsating so high in the neck, that no amount of elevation of the clavicle by subjacent axillary aneurism could raise that bone above the level of the vessel. In the majority of cases, however, in 17 out of 25, as shown by Mr. Quain, in his work on the Arteries, it is either below the level of the bone, or but slightly raised above it; so that if the clavicle were thrust upwards and forwards, the vessel would be buried in a deep pit behind it. Dupuytren was of opinion that the artery coursed high in persons who were thin, with slender, long necks; whereas, in thick, short-necked persons, with muscular shoulders, it was deeply seated. I have often verified the truth of this observation both in dissection and in examining the pulsations of the vessel during life. In order to obviate the difficulty that has occasionally been experienced in reaching the artery when thus buried behind an elevated clavicle, it has been proposed by Mr. Hargrave to saw through the bone.

The most serious objection that can be raised against this practice is the fact of the clavicle being sometimes a part of the wall of the aneurism; but supposing the surgeon could satisfy himself that this was not the case, I cannot see any objection to this procedure, provided any very great and insurmountable difficulty presented itself in getting the ligature round the vessel without it.

In passing the needle round the subclavian, care must be taken that some of the lower cords of the brachial plexus be not included in the noose, and indeed the mistake has more than once been committed of tying these nervous trunks instead of the vessel: thus, Mr. Liston, in the first successful case of ligature of the subclavian in this country, passed the thread round the lower nervous cord; but immediately perceiving his error, turned it to account by drawing aside the included nerve, and thus more readily exposing the artery. Dupuytren, in a case of aneurism of some years' duration succeeded, after an operation that lasted one hour and forty-eight minutes, and which he describes as the most tedious and difficult he ever attempted, in passing a ligature round the vessel, as he believed. After the death of the patient, which occurred from hemorrhage on the fourth or fifth day, the fourth cervical nerve alone was found included in the noose. In a case related by Porter, it is stated that the artery communicated such distinct pulsation to the inferior nervous trunk, that there was no means of ascertaining whether it was the vessel or not, except by passing the needle under it.

In some cases, as has already been stated, the sac passes upwards below the clavicle into the inferior posterior triangle of the neck; when this is the case, the surgeon incurs the risk of puncturing it from its close proximity to the artery, as it lies on the first rib. This accident happened to Mr. Cusack while ligaturing the subclavian in the third part of its course, for a diffused aneurism of the axillary artery. An alarming gush of blood took place, which was arrested by plugging the wound, but the hemorrhage recurred on the tenth day, and the patient died. In a case related by Mr. Travers, in which the sac was punctured by the needle, which was being passed round the artery, the blood, which was arterial, did not flow *per saltum*, but in a continuous stream. "The hemorrhage," says Mr. Travers, "was more terrific and uncontrollable than I have ever witnessed," and was not commanded by drawing the ligature tight. It was so great that it was doubtful whether the patient would leave the theatre alive, and was only arrested by plugging the wound with sponge-tents. The patient died of inflammation of the pleura. On examination, the aneurismal sac was found to have a pouch-like enlargement upwards, overlying the artery, where it had been punctured.

If it be found that the sac encroaches upon the neck, rising above the clavicle,

or that the artery is not sound in the third part of its course, it may be necessary to ligature it between the scaleni, by dividing the outer half or two-thirds of the scalenus anticus. This operation should not be considered as one distinct from the ligature of the vessel in the third part of its course, but rather as an extension of that proceeding, if it be found, for the reasons just mentioned, unadvisable to tie the artery on the first rib; in this way it has been practised by Dupuytren and Liston. In its first steps, as far indeed as the exposure of the scalenus anticus, it is the same as that for the deligation of the vessel in the third part of its course. When this muscle has been exposed, a director must be pushed under it, upon which it is to be divided to the extent of half or two-thirds its breadth, when it retracts, exposing the vessel. During this part of the operation, some danger may be incurred to the phrenic nerve, and the transversalis colli and humeri arteries; but if ordinary care be taken, this will not be very great. The phrenic nerve, as I have found by very frequent examinations on the dead body, lies altogether to the tracheal side of the incision, if that be not carried beyond one-half the breadth of the muscle; and should it appear to be in the way, may readily be pushed inwards towards the mesial line, being only loosely invested by cellular tissue. I have, however, seen one instance in which the right subclavian artery was ligatured for a spontaneous cylindriform aneurism of the axilla, and the patient died on the eighth day, of pneumonia; on examination after death, the edge of the scalenus was found cut, and the phrenic nerve divided. Had the pneumonia in this case anything to do with the injury to the nerve? I do not think it improbable, as division of one phrenic by paralyzing to a certain extent the diaphragm, and so far interfering with the respiratory movements, must necessarily have a tendency to induce congestion of the lung, which would readily run on to inflammation of that organ. I have likewise heard of one case in which incessant hiccough followed this operation, and after death the phrenic nerve was found reddened and inflamed, having probably in some way been interfered with during the exposure of the vessel.

Another important point in reference to the ligature of the vessel in this part of its course is the frequency with which a branch arises from the subclavian artery between the scaleni. When this peculiarity exists, there would probably be but a slender chance of the occlusion of the artery by ligature in this situation. The transversalis colli and humeri arteries, though in some danger, whilst crossing over the scalenus anticus, may be avoided by keeping the incision in the muscle between and parallel to these vessels. One principal danger in ligaturing the subclavian artery at any point above the first rib, certainly arises from interference with the fine cellular tissue which lies between it and the scalenus muscles, separating it from the pleura, and which is continuous with the cellular membrane of the anterior mediastinum, being indeed the deep portion of the ascending layer of what Sir A. Cooper has described as the "thoracic fascia," and which tends to form the superior boundary of the chest, being continuous in the neck with the deep cervical fascia. After the deeper layers of the cervical fascia have been opened, this fine cellular membrane presents itself, and if inflammation be excited in it, the morbid action will readily extend by mere continuity of tissue into the thorax by the anterior mediastinum, invading ultimately the pleura and pericardium. Hence, whenever it is practicable, the surgeon should keep the point of the needle close to that part of the artery which lies upon the first rib, as there is less risk here of opening into the deep cellular tissue of the neck.

The general result of the ligature of the subclavian artery in the third part of its course, for spontaneous aneurism in the axilla, is by no means satisfactory. Thus, of 47 cases of aneurism of the axillary artery, not dependent upon any external wound, in which the artery was ligatured above the clavicle, I find 23 cures against 24 deaths. This result is so unfavorable, and so different, indeed,

from what I had anticipated, that I was led to analyze carefully the causes of death. I find them as follows: —

Inflammation within the chest, &c.	10 cases.
Suppuration of the sac	6 "
Hemorrhage	3 "
Gangrene of hand and arm	1 "
General gangrene	1 "
Not stated	3 "
	24 "

Thus it will be seen that the two most frequent causes of a fatal result following the operation for axillary aneurisms, are not those that are usually met with after the ligature of the larger vessels. It would therefore appear to be owing to some special condition, dependent either upon the application of a ligature to the subclavian artery in the third part of its course, or upon the situation and nature of the disease for which that operation is had recourse to; and the important point to be determined is, whether these conditions are the accidental or the necessary consequences of the application of a ligature in this situation for the cure of aneurism in the axilla.

The *inflammation of the contents of the thorax* proved fatal in 9 out of 22 cases, or 1 in 2·5, and is the most frequent cause of death, though not, I believe, the most frequent untoward complication of this operation. It might at first be supposed that in this respect the operations on the subclavian artery resembled other of the greater operations, after which pneumonia is so common a sequela; but on closer examination it will be found that this is not the case, that the inflammation, when attacking the thorax or its contents after ligature of this artery for axillary aneurism, is not confined to the lungs, but very commonly affects the pleura and pericardium as well as or even in preference to these organs. It would, therefore, appear probable that it arose from causes that are essentially connected with this disease or operation. These are referable to three heads.

1st. Inflammation of the deep cellular tissue at the root of the neck, extending to the anterior mediastinum, the pleura and pericardium. This would appear to have been the cause of the supervention of inflammation in a patient of Mr. Key's, and has been especially adverted to by that excellent surgeon in the relation of the case of a patient on whom he performed this operation.

2d. The sac may, by its pressure inwards, encroach upon and give rise to inflammation of that portion of the pleura that corresponds to its posterior aspect. This occurred in a case in which Mr. Mayo, of Winchester, operated, and is more liable to happen if suppuration has taken place in the sac; when this happens, adhesion may take place between it and the pleura, or even the tissue of the adjacent lung, and the contents of the suppurated tumor be discharged into the pleural cavity or air-tubes, and so coughed up. Of this curious mode of termination there are at least two cases on record, one by Mr. Bullen, in which the patient recovered; the other by Dr. Gross, in which the patient died from the escape of the contents of the sac into the cavity of the pleura.

3d. Division of the phrenic nerve would necessarily, by interfering with the respiratory movements, induce a tendency to congestion and inflammation of the tissue of the lungs; and although such an accident must be a very rare one in cases of ligature of the subclavian for axillary aneurism, yet it undoubtedly has occurred, as I have myself witnessed in one case.

Suppuration of the sac is the most common, though not the most fatal accident after ligature of the subclavian for spontaneous axillary aneurism. It was the immediate cause of death in 6 cases, and occurred in 2 of the patients that

died of inflammation of the chest; and took place in 6 cases that recovered. in all 14 cases out of 45, or nearly 1 in 3, a much higher proportion than is generally observed in cases of ligature for aneurism.

What is it that occasions this greater frequency of suppuration of the sac in these than in aneurisms in other situations? The only cause to which it appears to be attributable is the great laxity of the cellular membrane in this situation, which allows the tumor to increase so rapidly in size as to excite inflammatory action in the surrounding tissues, which may speedily run into suppuration. So long as the contents of the tumor continue fluid, they will necessarily excite less irritation on surrounding structures; but when once they have become solidified, whether by the gradual deposition of laminated fibrine, during the progress of the disease, or more suddenly, in consequence of those changes that take place in the contents of an aneurismal sac after the ligature of the artery leading to it, the indurated mass acting like any other foreign body sets up inflammation in the cellular tissue that is in immediate contact with it, and thus disposes it to run into suppuration. The more speedily the solidification takes place, the more disposition will there be to the occurrence of this accident, the neighboring parts being unable to accommodate themselves to the sudden extension and compression they are compelled to undergo.

The period at which suppuration of the sac may be expected to occur in cases of axillary aneurism, after the ligature of the subclavian, must necessarily in a great measure be dependent on the state of the sac at the time of the operation. If inflammatory action have already set up around it, it may happen in a few days after the artery has been tied. But if this morbid action have not already commenced, the period at which suppuration may most probably be expected is between the first and second month. The period at which suppuration and rupture of the sac take place does not influence the probable termination of the case to any material extent; as in the cases that proved fatal, death occurred at various periods between the seventh day and the second month; in Aston Key's case, on the ninth day, in Mayo's, on the twelfth, in Belardini and Graefe's, at the end of the first month, in Rigaud's at the sixth week, in B. Cooper's in the second month. The recoveries, likewise, took place at all periods after the ligature of the vessel, between a few days, as in Porter's, and six weeks, as in Halton's case.

An axillary aneurism that has suppurated may either burst externally or into the lungs or pleura, or both. It is most usual for it to burst externally; the tumor enlarging, with much pain and tension, a part of the skin covering it becomes inflamed, fluctuation can here be felt, and if an incision be not made into it, it will give way, discharging most usually a quantity of dark-colored pus, mixed up with more or less broken down and disintegrated coagulum and fibrinous deposit, and perhaps sooner or later followed by a stream of arterial blood.

Occasionally, but more rarely, the sac extending backwards becomes adherent to the pleura, and may give way into that cavity, or by pressing upon, may become incorporated with the lungs. Of this remarkable termination, two instances are recorded, in one of which recovery took place.

The first case of the kind is one in which Mr. Bullen ligatured the subclavian artery for axillary aneurism. Eighteen days after the operation the tumor began to increase, and to take on the symptoms that are indicative of suppuration. On the twenty-sixth day six or eight ounces of bloody pus were expectorated during a paroxysm of coughing, and the tumor suddenly diminished to one-half its size; it was now punctured, and five ounces of the same kind of matter let out with great relief. When the patient coughed, air passed into and distended the sac through an aperture between the first and second ribs, near their sternal extremities, through which the contents of the tumor had escaped into the lung. The discharge from the external aperture greatly decreased,

the cough lessened, and finally, three months after the operation, the patient was quite well.

Dr. Gross tied the subclavian artery for axillary aneurism on the 18th of February. After the performance of the operation the contents of the tumor solidified, and its volume progressively diminished. On the 15th of March, the patient suffered from fever, and slight tenderness on the apex of the tumor was perceptible. On the 16th, he was suddenly seized with intense pain in the chest, which was particularly severe at the base of the right lung, and extended up towards the axilla. The respiration throughout the right lung was bronchial, and there was dulness on percussion over the lower ribs; the aneurismal tumor had suddenly disappeared at the time of the attack. On the 18th, the patient experienced a sensation, as if a fluid was passing from the pleuritic cavity into that of the aneurismal tumor; and, upon auscultating, a plashing sound was heard at every inspiration, the noise resembling that produced by shaking water in a closed vessel. On the 20th he died. Upon dissection the aneurism was found to communicate by an aperture, one inch and three-quarters in length, by an inch and a half in width, with the pleural cavity; this opening was situated between the first and second ribs, and was obviously the result of ulceration and absorption, caused by the pressure of the tumor. Both ribs were denuded of their periosteum. The right side of the chest contained nearly three quarts of bloody serum, intermixed with laminated clots and flakes of lymph; the former of which had evidently been lodged originally in the aneurismal sac (Norris, in American journal, 1845, p. 19). Besides these cases, a somewhat similar one has been recorded by M. Neret, of Nancy. A patient was admitted into the hospital, laboring under hemoptysis, and on examination was found to have an aneurism of the left subclavian artery as large as a chestnut. He died shortly after admission, and on examination the aneurism was found to communicate with a large cavity in the upper part of the lung.

The cause of death in Dr. Gross' case was probably the fact of the sac opening and discharging its contents into the pleural cavity. This does not appear to have occurred in Mr. Bullen's, in which a communication was established directly with the lung, the contents of the abscess finding exit through the air-tubes, as is the case, occasionally, in hepatic abscess, adhesion having previously taken place between the opposed surfaces of the pleura.

The principal danger, and the most frequent cause of death after the suppuration of the sac, is the supervention of profuse arterial hemorrhage. This may either occur from the distal extremity of the artery opening into the sac, or from one of the large branches which serve to support the collateral circulation round the shoulder, such as the subscapular or posterior circumflex, coming off either immediately above or below the sac, or from the sac itself. When hemorrhage does not take place after the suppuration of the sac, it must be from the fortunate circumstance of the occlusion of the main trunk, where it opens into the tumor. It can scarcely be from the occlusion of the principal collateral branches, as there would, in this event, be a difficulty in the preservation of the vitality of the limb. It is easy to understand, that if the sac spring from the axillary, at a little distance above the orifices of the subscapular and circumflex arteries, all that portion of the main trunk which intervenes between the tumor and these vessels might be occluded, and thus hemorrhage be prevented on suppuration taking place; whilst the collateral circulation would take place uninterruptedly through these vessels. If this portion of the artery have not been occluded by inflammatory action, the safety of the patient must depend upon the accident of a coagulum or piece of laminated fibrine being fixed or entangled in the mouth of the sac. This may prevent for a time the escape of arterial blood, which, on such a plug being loosened, may break

forth with impetuosity, and either at once, or by its recurrence at intervals, carry off the patient.

Another danger may be superadded in these cases on the suppuration of the sac and the supervention of hemorrhage, namely, the occurrence of inflammation of the pleura, lung, and pericardium, from the extension inwards of the morbid action going on in the sac.

Secondary hemorrhage does not frequently occur in cases of ligature of the subclavian artery in the third part of its course, except as a consequence of suppuration of the sac. I am only acquainted with two cases in which it proved fatal from the hemorrhage taking place from this artery at the part ligatured. One of these happened to Liston, and the preparation is preserved in the Museum of the College of Surgeons (No. 1695). In this case, it may be seen that the artery was diseased at the point ligatured, and that the bleeding occurred, as usual, from the distal side of the ligature.

Gangrene of the hand and arm is but seldom met with as a sequela of the operation we are considering. This is doubtless owing to the freedom of the anastomosing circulation between the branches of the transversalis colli and humeri, and those of the subscapular, circumflex, and thoracic acromial arteries; as well as between the superior thoracic and the branches of the first and second intercostals and internal mammary, by which the vitality of the limb is readily maintained. The principal risk from gangrene would doubtless arise from the subscapular artery being in any way occluded or implicated in the disease, as it is on the anastomosis of this vessel that the limb is mainly dependent for its supply of blood. But, at all events, this danger is small, the only case in which it appears to have given rise to a fatal termination being one in which Mr. Colles tied the artery; gangrene of the limb coming on after much constitutional disturbance of a low type, with rapid, weak pulse, thirst, sweats, restlessness, and delirium. In Blizard's case, there was sloughing of the sac, and pericarditis, the gangrene being confined to two fingers; and in Brodie's case, it occurred in both the lower as well as in the upper extremity, and must, therefore, have proceeded from some constitutional cause, altogether independent of the mere arrest of circulation through the subclavian.

The case of an axillary aneurism becoming inflamed, and threatening to run into suppuration before the surgeon has had an opportunity of ligaturing the subclavian artery, is one that is full of important practical considerations, and one that admits of little delay, for if the sac rupture, or be opened, fatal hemorrhage is the necessary and inevitable result. It would obviously be impossible, in a case of spontaneous aneurism, with any fair chance of success, to lay open the tumor, turn out the coagula, and ligature the vessel above and below the mouth of the sac; the coats of the artery being not only diseased, but still further softened by inflammation and supervening suppuration, would not be in a condition to hold a ligature. There are two other courses open, viz., the ligature of the vessel, or amputation at the shoulder-joint, and in the selection of one or other of these, the surgeon must be guided by the progress the disease has made, the condition of the limb as to circulation and temperature, and whether the contents of the tumor are solid or fluid.

If the tumor be of a moderate size, and circumscribed, the arm of a good temperature, and not very œdematous, the ligature of the artery may hold out a reasonable chance of success. It is true that this is but a chance; for as the blood will, immediately after the noose is tied, be carried by the supra and posterior scapular arteries into the subscapular and circumflex, and by them into the axillary at no great distance from the mouth of the sac, or enter, perhaps, directly into the mouth of the latter if the profunda or circumflex should chance to take their origin from the dilated portion of the vessel, the only safeguard against the supervention of hemorrhage as soon as the sac has burst or been opened or has discharged its contents, will be the occlusion by

inflammatory action of that portion of the artery that intervenes between these two collateral branches and its mouth, or the accidental entanglement in the latter of a mass of laminated fibrine. Yet under the circumstances, as to the condition of tumor and limb that have just been mentioned, it would be but right for the surgeon to give the patient a chance of preserving his limb.

Should, however, hemorrhage occur on or after the discharge of the contents of the sac, the subclavian having previously been ligatured, what should be done? If the bleeding be moderate, an attempt should be made to arrest it by plugging the wound, and by the application of a compress and bandage. If it recur, or is so profuse as to threaten the life of the patient, what course should the surgeon then pursue? Two lines of procedure are open to him: either cutting through the pectoral muscles so as to lay the sac open fully, and attempting to include the bleeding orifice between two ligatures, or amputation at the shoulder-joint.

If a surgeon were to undertake the first of these alternatives in a case of spontaneous aneurism, of which alone we are now speaking, he would, in all probability, find the part in such a condition as would prevent the possibility of his completing the operation he had commenced. After laying open a large sloughing cavity, extending under the pectoral muscles, perhaps as high as the clavicle, and clearing out the broken-down coagula and grumous blood it contains, in what state would he find the artery? Certainly, the probability would be strongly against its being in such a condition as to bear a ligature, even if it could be included in one. Its coats, in the immediate vicinity of the sac, could not, in accordance with what we know to be almost universally the case in spontaneous aneurisms of large size or old standing, be expected to be in anything like a sound, firm state, and would almost certainly give way under the pressure of the noose; or the vessel might have undergone fusiform dilatation, as is very common in this situation, before giving rise to the circumscribed false aneurism, in which case it would be impossible to surround it by a ligature; or, again, the subscapular or circumflex arteries might arise directly from, and pour their recurrent blood into the sac or the dilated artery, and lying, as they would, in the midst of inflamed and sloughing tissues, no attempt at including them in a ligature could be successfully made. Under such circumstances as these, the danger of the patient would be considerably increased, by the irritation and inflammation that would be occasioned by laying open and searching for the bleeding vessel in the sac of an inflamed, suppurating, and sloughing aneurism, and much valuable time would be lost in what must be a fruitless operation; at the close of which it would, in all probability, become necessary to have recourse to disarticulation at the shoulder-joint, and thus remove the whole disease at once. I should, therefore, be disposed to have recourse to disarticulation at the shoulder-joint at once, in all cases of profuse recurrent hemorrhage, following sloughing of the sac of an axillary aneurism, which could not be arrested by direct pressure on the bleeding orifice, after the subclavian has been tied.

There is another form of axillary aneurism that requires immediate amputation at the shoulder-joint, whether the subclavian artery have previously been ligatured or not; it is the case of diffuse aneurism of the armpit, with threatened gangrene of the limb.

Ligature of the axillary artery. — Should ligature of the axillary artery at any time be required, the vessel may be secured in two ways, in the space that intervenes between the lower margin of the clavicle and the fold of the axilla.

The first is by an incision, either straight or somewhat semi-lunar, parallel to and immediately below the inferior border of the clavicle; this must be carried through the pectoral muscle, and when this is divided, some loose cellular tissue, in which the thoracica suprema artery ramifies, is exposed.

This must be scratched through cautiously, until the fascia covering the vessels is reached. On opening this, which must be done in the most careful manner, by making a small aperture in it and then passing a grooved director under it, the vein first comes into view. This must be drawn downwards, when the artery will be found immediately above and behind it in the deep hollow formed by the clavicle above, and the edge of the lesser pectoral below. This operation is an exceedingly difficult one, on account of the depth and narrowness of the wound and the muscular character of its walls, as well as from the embarrassment occasioned by the numerous venous and arterial branches which ramify across the space in which the artery lies. After the vessels have been exposed, the passage of the ligature around them will be greatly facilitated by bringing the arm to the side of the body, so as to take off all tension in the wound.

The safer and simpler operation consists in making an incision from the centre of the clavicle directly downwards, in the course of the vessels, to the middle of the anterior fold of the axilla. In this way the skin, superficial fascia, and pectoralis major must be successively divided. The lesser pectoral will then be exposed, and the artery may either be ligatured below this, without further division of muscular substance, or if it be thought desirable to deligate it under this, the muscle must be cautiously cut through. When this is done a very distinct and firm fascia will come into view; this, being pushed up, must be carefully opened, when the artery and vein will be seen lying parallel to one another, the artery not being overlapped by the vein, as it is higher up. The vein having been drawn inwards, the aneurismal needle must be carried from above downwards between it and the artery. The great advantage of this operation is, that the wound is open and free, and that, consequently, the artery can be more readily reached in any part of its course. The disadvantage is the great division of muscular substance that it entails. This, however, need not leave any permanent weakness of the limb, as by proper position ready and direct union may be effected between the parts.

ANEURISM OF THE ARM, FORE-ARM, AND HAND.

Spontaneous aneurism rarely occurs below the axilla, but yet it may occasionally be met with at any part of the upper extremities. Thus Palletta, Flajani, Pelletan, and others, relate cases of spontaneous aneurism at the bend of the arm; and Liston states that he once tied the brachial artery in an old ship-carpenter, who, whilst at work, felt as if something had snapt in his arm. Mr. Pilcher has recorded a case of aneurism under the ball of the right thumb, which was produced by repeated though slight blows with the handle of a hammer used by the patient, a working goldsmith, in his trade; the radial and ulnar arteries were tied immediately above the wrist, and the disease thus cured. Aneurism has also been met with in this situation after attempted reduction of the thumb. Spontaneous aneurism in the fore-arm is of extremely rare occurrence. I am only acquainted with one, that recorded by Mr. Todd, as occurring in a woman twenty-eight years of age, which had existed for several years before the brachial was ligatured, when pulsation in the tumor ceased, though it continued solid and hard for some months after the operation, and in 1849, a man was admitted into University College Hospital, for a tumor that presented all the characters of aneurism, and that was situated in the upper third of the ulnar artery of the right fore-arm. The brachial was ligatured by Mr. Arnott, when pulsation and bruit ceased in the tumor, though some enlargement of the arm continued for some time afterwards.

Rare as spontaneous aneurisms are in these situations, the traumatic forms of the disease are, as has already been stated (page 178), of frequent occurrence,

and may require the ligature of the brachial, or of either of the arteries of the fore-arm.

In cases of aneurism in this situation, direct pressure might be tried with advantage, provided they are of small size and unattended by inflammation of the superjacent integuments. Compression to the trunk of the artery above the tumor is rarely applicable on account of the pain that is induced by the pressure upon the neighboring nerves which cannot be isolated from the artery.

LIGATURE OF THE BRACHIAL ARTERY.—The brachial artery may be ligatured in the middle of the arm, which is considered the seat of election of this operation, by making an incision about three inches long, parallel to and upon the inner edge of the biceps, which is the "directing line;" the fascia, which is exposed, must be opened carefully to a corresponding extent, when the median nerve will commonly be seen crossing the wound; this must be drawn downwards with a blunt hook, when the artery, accompanied by its two veins, will be exposed; these vessels must then be separated from one another, and the ligature passed and tied in the usual way. In performing this operation the principal point to attend to is to cut down upon the inner edge of the biceps, which will be the sure guide to the artery. If the surgeon keep too low, he may fall upon the ulnar nerve and the inferior profunda artery, which might possibly be mistaken for the brachial; but by taking care to expose the lower fibres of the biceps in his early incision, he will avoid this error.

In the upper part of the arm, the brachial artery, where the axillary terminates in it, will be found lying immediately behind, and covered by its vein. On drawing this to the inner side, the artery will be seen, the plexus of nerves being somewhat above and behind it. In ligaturing the artery in this situation, care must be taken to divide the integuments, which are extremely thin, with great caution; when by rotating the arm outwards and bending the elbow, the artery will be thrown forward and rendered less tense, so that a ligature can easily be passed around it.

At the bend of the arm, the brachial artery may be reached by making an incision about two inches in length in a direction downwards and inwards, about half an inch internal to the edge of the tendon of the biceps. After carrying it through the skin and fascia, the vessel will be found accompanied by its veins, in the triangular space bounded externally by the biceps tendon, and internally by the pronator teres. In performing this operation, the veins at the bend of the arm, with the filaments of the internal cutaneous nerve, must be divided to some extent, though they should be spared as much as possible. The artery will be found about half an inch to the inner side of the tendon, accompanied by the median nerve, which is to its ulnar side.

The *radial and ulnar arteries* should never, I think, be ligatured above the middle third of the arm except in cases of direct wound; any attempt at deligating them at the upper part of the fore-arm, will not only be attended with great difficulty, but with the danger of crippling the muscles in this situation, and thus impairing the after movements of the arm, and may always have the ligature of the brachial substituted for it.

The radial artery may be ligatured near the wrist, by making an incision about two inches in length, half an inch to the outside of the tendon of the flexor carpi radialis, the "directing line;" when, after the division of the superficial and deep fascia, the artery, accompanied by its two veins, will be exposed, and may be tied in the usual way.

The ulnar artery above the wrist, may be readily ligatured by making an incision about two inches in length, a little above, and one-third of an inch to the radial side of the pisiform bone, parallel to the tendon of the flexor carpi ulnaris, which is the "directing line" to the vessel. After dividing the fascia covering it, the artery, with its two accompanying veins, will be found to the radial side of the ulnar nerve.

CHAPTER XXXIX.

ANEURISM BY ANASTOMOSIS, AND NEVUS.

Aneurism by anastomosis, is a disease of the arteries, in which the vessels become excessively elongated, tortuous, and serpentine; sometimes they assume a varicose condition, being dilated into small sinuses, and are always very thin-walled, resembling rather veins than arteries in structure. This kind of dilatation of the vessels will give rise to pulsating tumors, often of considerable size, and of a very active and dangerous character. They may be situated in almost any tissue or organ of the body, but are most commonly met with in the submucous and subcutaneous cellular tissue, and most frequently occur in the upper part of the body, especially about the scalp, orbit, lips, and face; but they have been met with in other situations, such as the tongue, and even in internal organs, as the liver, and I have seen very active growths of this kind on the nates and foot. In some cases, aneurism by anastomosis occurs in bones, in which it forms a special disease, and is not uncommonly associated with encephaloid. Indeed, there is certainly a great tendency for aneurism by anastomosis and encephaloid to run into one another, the limits between them not being very clearly defined, especially when occurring in connection with osseous tissue. It will generally be found that the arteries leading to, though at a considerable distance from the aneurism by anastomosis, are tortuous, enlarged, with thin and expanded coats, and pulsate actively; in fact, constituting that condition that goes by the name of *cirsoid* dilatation of the vessels.

Aneurism by anastomosis forms tumors of varying magnitude and irregular shape; they are usually of a bluish color, have a spongy feel, are readily compressible, not circumscribed, and with large tortuous vessels running into and from them on different sides. Their temperature is generally above that of neighboring parts; and a vibratory or purring thrill, amounting in many cases to distinct pulsation, may be felt in them. This pulsation or thrill is synchronous with the heart's beat, may be arrested by compressing the tumor or arteries leading to it, and returns with an expansive beat on the removal of the pressure. The bruit is often loud and harsh, but at other times of a soft and blowing character. These growths rarely occur in infancy, but generally make their appearance in young adults, though they may be met with at all periods of life, and often as the consequence of an injury of some kind.

It is of importance to effect the diagnosis between ordinary aneurism and that by anastomosis. In many cases the situation of the tumor at a distance from any large trunk, as on the scalp, the outside of the thigh, or the gluteal region, will determine this. Then again the outline of the growth is less distinct than in true aneurism; and tortuous vessels will be felt leading to it from different directions. The swelling also is doughy, and very compressible; but when the pressure is removed, the blood enters it with a whizz and thrill, not with the distinct pulsating stroke that is found in aneurism. The pulsation, not so forcible as in aneurism, is more heaving and expansive. The bruit is louder, more superficial, sometimes having a cooing note. By pressure on the arteries leading to the tumor, these signs are usually not entirely arrested, though diminished in force, the blood entering it from the neighboring parts, and in a less direct way.

The *treatment* of aneurism by anastomosis must depend upon the size and situation of the growth. When it is so placed that it can be ligatured or excised, as on the lip, or when of small size, about the neck, face, or scalp, it should be removed in one or other of these ways. I always prefer, in cases of nevus, the ligature applied, as will immediately be described, as being the safest,

and upon the whole the readiest mode of getting rid of such a tumor. If excision be practised, it is necessary to be very careful to cut widely of the disease; if it be cut into, fearful hemorrhage may ensue, which can only be arrested by pressure, and which in several instances has proved fatal.

If the disease be very large and extended, as is commonly seen on the scalp, or when deeply seated, as on the orbit, neither ligature nor excision of the tumor can be practised, and it becomes necessary to starve it by cutting off its supply of blood. This may be done either by ligaturing the principal branches leading to it, or the main trunk of the limb or part. The simple ligature of the arterial branches leading to the tumor has never, I believe, been followed by success, at least in 10 recorded instances in which it has been had recourse to, the disease has not in one instance been cured. It has, however, been successfully conjoined by Dr. Gibson, in 2 cases of aneurism by anastomosis of the scalp, with incisions made round the tumor at intervals between the principal feeding arteries, which at the same time were tied.

The main trunk leading to the tumor has been ligatured in a considerable number of cases. The brachial and femoral arteries have been tied for disease of this kind situated on the extremities, and in some instances with success; but the carotid is the vessel that has been most frequently deligated in consequence of the tumor being so commonly situated on the scalp and in the orbit. This operation has been done in 20 recorded cases, and in 5 instances both the carotids were ligatured at intervals of several weeks. In all of those cases in which the double operation was performed, the patients ultimately recovered. In some of the cases in which one carotid alone was tied, the disease being seated upon the scalp, was not cured, and it was afterwards found necessary to have recourse to ligature of the tumor, to excision, and to other means of removal; indeed, when seated upon the scalp, this disease appears to be more intractable than in any other part of the body, owing probably to the freedom of the arterial supply from the numerous vessels that ramify in this region. Here, however, much benefit might be derived after ligature of the carotid, by adopting the plan suggested by Dr. Gibson, of tying the feeding arteries, and making incisions between them down to the bone. The ligature of the carotid has answered best for diseases of this kind in the orbit; of 6 instances in which the artery has been tied for aneurism by anastomosis in this situation, in 5 a cure was accomplished.

NEVUS.

This disease, under which those various affections are included, termed *mother's marks, erectile tumors, and vascular growths,* constitutes an important and interesting section of surgical affections. It appears to consist essentially in an excessive development of the vascular tissue of a part, and differs greatly as to nature, cause, and treatment; according as the arterial, the capillary, or the venous elements of the tissue predominate. The predominance of the arterial tissue we have already considered, under the head of aneurism by anastomosis, it now remains for us to describe the capillary and venous nevi.

Capillary nevi appear as slightly elevated but flat spots on the skin, of a bright red or purplish tint, and having occasionally granular or papillated elevations, with some larger vessels ramifying on their surface. They often spread superficially to a considerable extent; they are usually situated on the face, head, neck, or arms, but occasionally, though more rarely, on the back, the nates, the organs of generation, and the lower extremities; they are, I believe, always congenital, though often at birth of a very small size, not larger than a pin's head, from which they may spread in the course of a few weeks or months to patches an inch or two in diameter. In many cases no inconvenience results from this disease, except the deformity it entails, but occasionally, more especially when

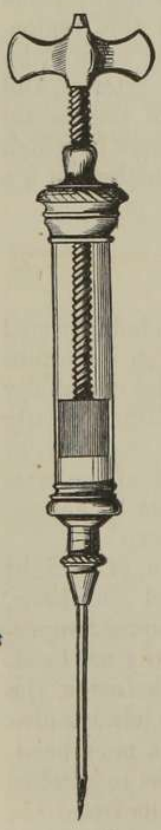
the growth is at all prominent, there is a great disposition to ulceration of an unhealthy and hemorrhagic character. When bleeding occurs, it is usually in a trickling stream, and without any degree of force.

Venous nevi are of a dark purple or reddish color, usually very prominent, and often forming distinct tumors of considerable size, which may either be smooth and ovoid, or else somewhat lobulated. On compressing a growth of this kind, it subsides to a certain extent, feeling doughy, soft, and inelastic, and on the removal of the pressure fills up again. In some cases, when consolidated by inflammation, or containing cysts, it cannot be lessened in bulk by pressure. These nevi are usually about the size of half a walnut, but sometimes much larger. I have removed them from the nates and the back fully as large as an orange. They less frequently occur upon the head and face than the capillary form of the disease; most of the instances that I have seen have been met with in the lower part of the body, about the nates, back, lower extremities, and organs of generation.

Subcutaneous nevi are occasionally met with, of a mixed character, forming soft, doughy, and compressible tumors, which may be recognized by being capable of diminution by pressure, on the removal of which they slowly fill out again to as large a size as before; they also become distended when the child screams or struggles, and are usually of an oval shape, smooth, and uniform. The skin covering the tumor is often unaffected; at other times it is implicated in an oval patch on the most prominent part of the growth, and occasionally the surrounding veins are bluish and enlarged.

In structure, the capillary nevi appear to be composed of a congeries of small tortuous vessels, of a capillary character; the venous nevi appear made up of thin tortuous veins, dilated into sinuses and small pouches. In the midst of these masses, cysts are not uncommonly found, sometimes containing clear, at other times, a dark, sanguinolent fluid. These cysts are probably venous sinuses, the openings into which have become occluded.

Fig. 192.



The *treatment of nevi* may be conducted on three principles. 1st, by means calculated to excite adhesive inflammation in them, and so to produce plugging and obliteration of the vascular tissue of which they are composed; 2d, by agents that destroy the growth; and 3d, by removal with the knife or ligature. Each of these different plans of treatment is peculiarly applicable when the disease assumes certain forms, and affects certain situations.

1st. When the disease is of small size, and occurs in such situations that its destruction by caustics, or removal by knife or ligature, would be attended by serious deformity, as when it is seated about the eyelids, upon the tip of the nose, at the inner angle between the eye and the nose, or about the corners of the mouth, it is best to endeavor to procure its obliteration, by exciting the adhesive inflammation in it. This may be done in various ways. If small, the nevus may be vaccinated. If larger, the most convenient plan consists, perhaps, in passing a number of fine silk threads across the tumor in different directions, and leaving them in for a week or two at a time, until they have produced sufficient inflammation along their tracks, then withdrawing them, and passing them into other parts of the tumor. In this way its consolidation may gradually be effected. Another very useful plan is to break up the substance of the growth subcutaneously, by means of a cataract needle, or tenotome, and in the intervals between the different introductions of this instrument to keep up pressure upon it. In other cases, again, passing acupuncture

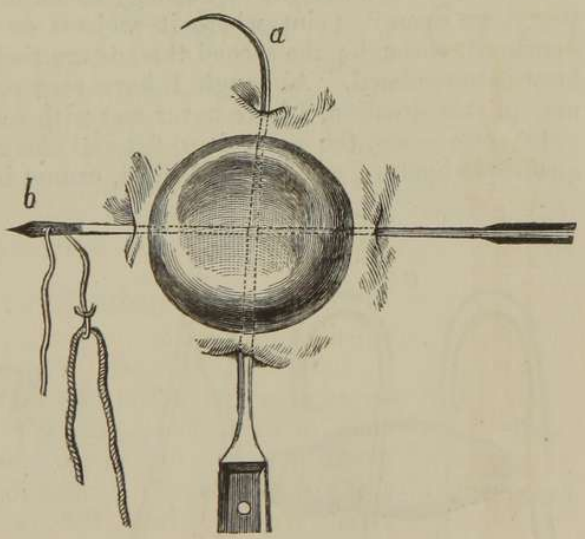
needles into it, and then heating them by means of a spirit-lamp, or injecting the perchloride of iron into it by means of a small glass syringe with a screw-piston rod and a fine sharp-pointed nozzle (fig. 192), will induce the requisite amount of inflammation. In all these different ways the surgeon may succeed in curing the disease.

2d. When the nevus is small, very superficial, of the capillary character, with an exceedingly thin covering of cuticle, and so situated, as upon the arm, neck, or back, that a moderate amount of scarring is of little consequence, it may most conveniently be removed by the free application of nitric acid. This should be well rubbed on by means of a piece of stick, and after the separation of the slough produced by it, its application must be repeated as often as there is any appearance of the granulations springing up, which will occasionally happen at one angle of the wound, and is indicative of a recurrence of the vascular growth.

3d. When the nevus is of large size, constituting a more or less distinct tumor, and is of a somewhat venous character, it may occasionally be excised. In doing this, however, care should be taken to cut wide of the disease, and no operation with the knife should be undertaken unless the growth be either so situated, as upon the lip, that the parts may readily be brought or compressed together, or upon the nates or thigh, and of a very indolent and venous character. As a general rule, it is far safer, and more convenient, to extirpate the growth with the ligature, and this, indeed, is the mode of treatment that is most generally applicable to tumors of this kind in whatever situations they may occur, as it effectually removes them without risk of hemorrhage, and leaves a sore that very readily cicatrizes.

The ligature requires to be applied in different ways, according to the size and situation of the tumor. In all cases, the best material for this purpose is firm, round, compressed whipcord. This should be tied as tightly as possible, and knotted securely, so that there may be no chance of any part of the tumor escaping complete and immediate strangulation. It is well, if possible, not to include in the noose any healthy skin, but to snip across with a pair of scissors that portion of integument which intervenes between the cords that are tied together; at the same time care must be taken to pass the ligatures well beyond the limits of the disease.

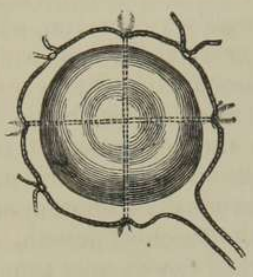
Fig. 193.



When the tumor is small, an ordinary double ligature may be passed across its base, by means of a common suture needle, and the noose being cut and the thread tied on either side, strangulation will be effected. When of larger size, and of round shape, the most convenient plan of strangulating the tumor is that recommended by Liston. It consists in passing, by means of long nevus-needles, fixed in wooden handles, and having the eye near their points, a double whipcord ligature, in opposite directions across the tumor; then cutting through either noose, and tying together the contiguous ends of the ligature until the whole of the growth is encircled and strangled by them. In doing this, a few precautions are necessary: thus, the

first nevus-needles should be passed across the tumor unarmed (fig. 193 *a*), and used to raise up the growth somewhat from subjacent parts. The second needle, armed (fig. 193 *b*), as represented in the annexed wood-cut, carrying the whip-cord ligature by means of a piece of suture silk, should be passed across the tumor in the opposite direction to, but underneath the first needle; the needle (*b*) being withdrawn, the ligature is carried across, and the first one having been armed in the same way, carries its noose through the tumor as it is drawn out. The two nooses having then been cut, an assistant must seize, but not draw upon, six of the ligature ends; the surgeon then having divided the intervening bridge of skin, ties pretty tightly, in a reef-knot, the two ends that are left hanging out; as soon as he has done this, he proceeds to the next two, and so on until he gets to the last (fig. 194). When he ties these, he must do so with all his force, especially if the tumor is large, as by drawing on them he tightens all the other nooses, and drags the knots towards the centre of the growth, which is thus effectually strangled. He then cuts off the tails of the ligature. After the tumor has sloughed away, which happens in a few days, if properly and tightly strangled, the sore is treated on ordinary principles. If the nevus is altogether subcutaneous, the skin covering it should not be sacrificed, but being divided by a crucial incision, may be turned down in four flaps, and the ligature then tied as directed. In some situations, as in the anterior fontanelle, it may be dangerous to pass the threads across the base of the tumor, lest the membranes of the brain which lay immediately beneath it be wounded. This difficulty I have readily overcome, by making a puncture on one side of the tumor, and then pushing an eyed-probe conveying the whip-cord across its base through the soft spongy tissue of which it is composed, and cutting down upon its point, where it projects on the opposite side of the tumor drawing it through; the second threads are tied in the same way, and the mass firmly strangulated. Although I have seen convulsions follow the ligature of nevi in this situation, I have never met with a fatal result.

Fig. 194.



In some cases, the nevus is so flat and elongated that the application of the quadruple ligature, as above described, cannot include the whole of it. Under

Fig. 195.

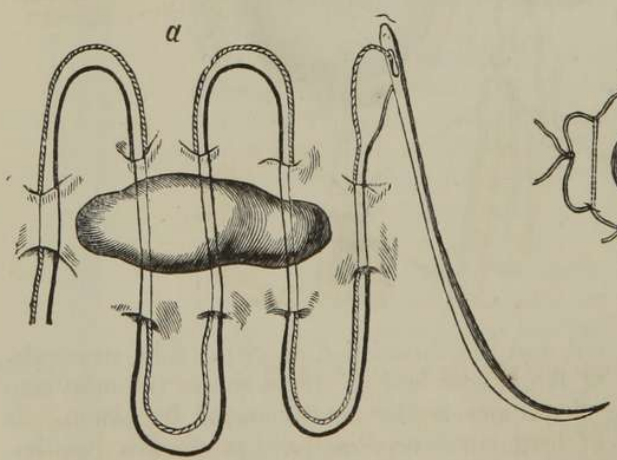
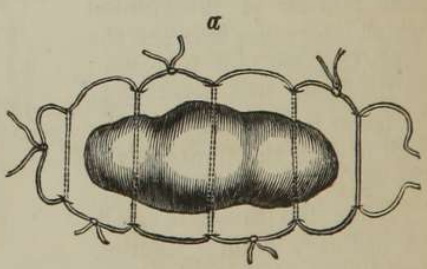


Fig. 196.



these circumstances, I have found the ligature about to be described eminently useful, having successfully employed it in a great number of instances. Its great advantage is, that while it completely and very readily strangles the

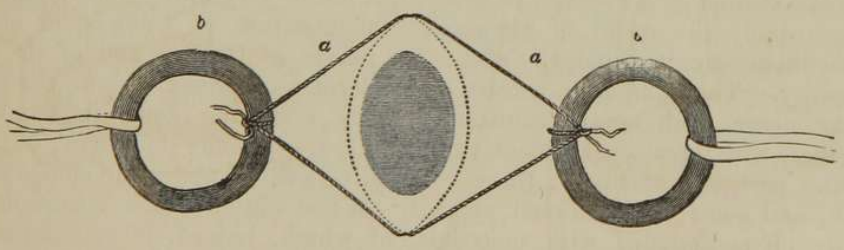
tumor, it does not inclose an undue quantity of integument, and thus does not produce a larger cicatrix than is necessary for the eradication of the disease. It is applied in the following way:—a long triangular needle is threaded on the middle of a whip-cord about three yards in length; one half of this is stained black with ink, the other half is left uncolored. The needle is inserted through a fold of the sound skin, about a quarter of an inch from one end of the tumor, and transversely to the axis of the same. It is then carried through, until a double tail, at least six inches in length, is left hanging from the point at which it entered; it is next carried across the base of the tumor, entering and passing out beyond its lateral limits, so as to leave a series of double loops about nine inches in length on each side (fig. 195). Every one of these loops should be made about three-quarters of an inch apart, including that space of the tumor, and the last loop should be brought out through a fold of healthy integument beyond the tumor. In this way we have a series of double loops, one *white*, and the other *black*, on each side (fig. 195). All the *white* loops should now be cut on one side, and the *black* loops on the other, leaving hanging ends of thread of corresponding colors.

The tumor may now be strangulated by drawing down and knotting firmly each pair of *white* threads on one side and each pair of *black* ones on the other. In this way the tumor is divided into segments, each of which is strangulated, by a nose and a knot: by *black* nooses and *white* knots on one side, by *white* nooses and *black* knots on the other (fig. 196).

The cicatrix resulting from the removal of a nevus is usually firm and healthy, but in some instances I have seen it degenerate into a hard warty mass requiring subsequent excision. The ligature may be used successfully at all ages. I have repeatedly tied large nevi in infants a month or two old, without meeting with any accident.

It has been proposed by Mr. Curling to ligature the nevus subcutaneously, by passing a thread around its base, under the skin, and then tightening it. This may succeed when the growth is of small size, and is useful when so situated that a cicatrix is objectionable. Mr. Startin has very ingeniously proposed a plan, which I have advantageously adopted in some cases, of elastic subcutaneous strangulation, by fixing a vulcanized india-rubber ring, put upon the stretch, on to the noose of the ligature, and then keeping up steady traction upon it. The annexed cut (fig. 197) represents a nevus with two ligatures (*a*, *a*) passed subcutaneously round it, in opposite directions, and attached to india-rubber rings (*b*, *b*), to which tapes are added, by which the traction is made.

Fig. 197.



HEMORRHAGIC DIATHESIS.

In connection with diseases of the arteries, it may be stated that, in some constitutions, it is found, though, fortunately, very rarely, that there is a great tendency to very troublesome, indeed almost uncontrollable, bleeding from trivial wounds; life being put in jeopardy, or even lost, by the hemorrhage resulting from the extraction of a tooth, the opening of an abscess, lancing the gums, or some equally slight, unimportant surgical procedure. The blood in

these cases does not flow in a jet, but continues to trickle in an oozing stream, apparently from the capillaries rather than the arteries of the part. This disposition is usually congenital, and in most cases hereditary; in other instances it appeared to result from the acquirement of some peculiar cachectic or scorbutic condition. The precise condition on which this hemorrhagic tendency is dependent has not been very clearly made out. When hereditary, it occurs in individuals who are robust, strong, and otherwise healthy. When acquired, it is usually met with in individuals who have been depressed in power by overwork, bad and insufficient food, or venereal excesses; and is evidently owing to defective nutrition. In all cases, the blood is thin and watery, apparently deficient in fibrine, and the capillaries easily lacerable and not sufficiently contractile. In such cases as these, care must be taken not to make any surgical wounds if they can possibly be avoided; though it is a remarkable fact, that this condition seems only to have been met with after trivial injuries of the kind above mentioned, and not to have been encountered in any really serious surgical case. In the treatment of the diathesis little can be done. It has been proposed to administer saline hydragogue purgatives, with a view of inspissating the blood. I should, however, imagine that an improvement of the general health, by careful attention to food, exercise, etc. would be the best means of increasing the plasticity of this fluid. In the event of actual bleeding occurring in such cases as these, the employment of pressure, or the application of the actual or electric cautery, will constitute the best means of arresting the hemorrhage. In some cases the electric cautery may be advantageously substituted for the knife, when it is desirable to remove parts in persons suffering from this diathesis. By this means, the smaller amputations even may be performed, as has been successfully done by Mr. Marshall.

CHAPTER XL.

DISEASES OF THE NERVOUS SYSTEM.

Inflammation of the nerves, or *neuritis*, is not of very unfrequent occurrence, being usually the result of rheumatic inflammation, of wounds, or strains. When rheumatic, it principally affects the nerves of the face and of the lower extremity. The symptoms consist of tenderness on pressure along the course of the nerve, with severe continuous pains, ramifying down its trunk and branches, with occasional violent exacerbations, especially on moving or touching the part, and at night; there is usually swelling along the course of the trunk, and some constitutional pyrexia. When chronic, this condition may readily be confounded with neuralgia, of which, indeed, it constitutes one variety. On examination after death, in these cases, the sheath of the nerve will be found injected and swollen, and the nervous tissue softened. The treatment consists in the employment of antiphlogistic means; cupping or the application of leeches, according to situation, poppy or belladonna fomentations, and local emollients. When rheumatic, the acetous extract of colchicum is the best remedy that can be administered; when of a more chronic and nocturnal character, the iodide of potass, either alone or in combination with sarsaparilla, may advantageously be given.

NEURALGIA.

In this disease, pain in the course of a nerve or greatly increased superficial sensibility, is the characteristic symptom. It is of all degrees of severity, sometimes moderate, at others unendurable, even by those who possess the greatest fortitude; when severe, it usually comes on suddenly, with a kind of shock, and continues of a sharp darting or tearing character, coursing along the trunk or ramifications of the affected nerve, the distribution of which may often be distinctly indicated by the direction the pain takes. It is often accompanied by other sensations, such as a tickling, smarting, or creeping feeling on the affected surface; in some instances relieved by pressure, in others increased by the slightest touch, or movement of the part. Occasionally there is spasm in the muscles supplied by the affected nerve; in others, heat and redness of the surface, with increased secretion from the neighboring organs, as a flow of saliva or tears, when the nerves of the eye or jaw are implicated. The duration of an attack may vary from a few moments to many days or months, the pain being most commonly intermittent or remittent, often irregularly so, but in some instances the periodicity is well marked.

This disease may affect almost any part of the body; it is most commonly seated distinctly in the trunk and branches of a nerve. The divisions of the fifth pair are especially liable to be affected; it may extend to the whole of the branches of this nerve on one side of the head and face, or more commonly it is confined to one of its principal divisions, such as the infra-orbital, which is especially liable to be affected by it; in many instances it is seated in the temporal and dental. Not unfrequently some of the terminal twigs merely, of one of these nerves, become the seat of intense pain; thus, occasionally, the affection is found limited to a patch on the cheek, brow, or temple; from which it scarcely ever shifts. The posterior branches of the dorsal spinal nerves, and the intercostals, are also very commonly affected, though not to the same extent as the fifth pair. In other cases the whole of an organ, or part, becomes the seat of neuralgia, though no one nerve may appear to be distinctly implicated; thus, the testes, the breast, the uterine organs, or one of the larger joints, as the hip or knee, is occasionally the seat of severe suffering of this kind. An extreme degree of cutaneous sensibility is a marked feature in the affection, in some cases the patient wincing and suffering severely whenever the skin is pinched or touched, however lightly.

The *causes* of this very painful disease, are very various; in many instances they appear to be purely of a nervous character; depressing influences of all kinds being especially likely to produce it; thus, debilitating diseases, mental depression, and particularly exposure to malaria, are common occasioning causes; those forms of the disease that arise from malarial influences, or from exposure to simple cold and wet, usually assume a very intermitting or periodical character, and are commonly seated in the nerves of the head. The hysterical temperament very frequently disposes to the spinal and articular forms of neuralgia. Various sources of peripheral irritation, as loaded bowels, the irritation of worms, and carious teeth, may be recognized as producing some of the more obscure varieties of the disease.

Neuralgia may also arise from any compression exercised upon the trunk of a nerve, and thus indeed some of the more intractable forms of the affection have their origin. Thus, the pressure of a tumor of any kind, or of a piece of dead bone, may give rise to the most intense pain in the part supplied by the irritated nerve; and it is not improbable that in many of the cases of neuralgia in the branches of the fifth, pain may be owing to periosteal inflammation, or other disease of the osseous canals, through which these nerves pass.

The *diagnosis* of neuralgia, though usually effected without any difficulty, is in some cases a little embarrassing, as the pain may occasionally simulate that

of organic disease or inflammation of a part. From organic disease of the part that is the seat of suffering, such as the hip, the knee, the testis, or the breast, this disease may usually be distinguished by the co-existence of cutaneous sensibility, the existence of the hysterical temperament, and the absence of the other signs that would accompany lesion of structure in the part affected. From inflammation the diagnosis is usually sufficiently easy by attending to the intermittent character of the neuralgic pain, its occurrence in hysterical temperaments, and in the absence of the constitutional symptoms of inflammation. But occasionally when local inflammatory irritation is conjoined with the neuralgia, the diagnosis is truly difficult. Here the presence of cutaneous sensibility and the relief of the pain by firm pressure will indicate neuralgia; whereas, in inflammation there is no tenderness of surface, but the suffering is aggravated by deep pressure.

The *treatment* of neuralgia must have reference to the cause of the disease, and will be successful or not according as this may be more or less readily removed. So long as the conditions that primarily occasion the disease subsist, the pain is likely to continue; and if these conditions are irremovable the disease may be looked upon as necessarily incurable, though the suffering may be alleviated by appropriate means. When arising from any central nervous affection, there may be the fear of the ultimate occurrence of disease of a more serious type, such as epilepsy, insanity, &c.

When occurring in the hysterical temperament, the administration of the more stimulating and stronger preparations of iron, such as the sulphate, the sesquichloride, or the mistura ferri comp., either alone or in combination with quinine, with attention to the state of the bowels and of the uterine functions, and a general tonic regimen calculated to brace and improve the general health, such as sea-bathing, the cold douche, or sponging will be found to be of essential service. In some of these cases the combination of zinc, especially the valerianate with the fetid gums, will remove the disease when iron does not influence it much. At the same time the application or inunction of belladonna or aconite plasters and liniments may be of service. When the neuralgia is distinctly periodical, quinine in full doses, or the liquor arsenicalis, will usually effect a speedy cure. When rheumatic, occurring in debilitated subjects, and attended by distinct nocturnal exacerbations of pain, no remedy exercises so great an impression upon it as the iodide of potass, especially when administed in combination with quinine.

In the more severe and protracted forms of the disease, relief may be occasionally obtained by attention to the state of the liver and digestive organs, by a course of some of the more purgative mineral waters, and by the occasional exhibition of aloetics or croton oil, followed by the administration of tonic remedies. In many cases, all these means, however, are unfortunately unavailing, and the sufferer is doomed to an existence of constant pain, except when the disease appears to cease of itself, or has its intensity blunted by the administration of the more powerful sedatives, such as morphia internally, or aconite or atropine externally. In these distressing cases, the sufferer is ready to grasp at any means of relief that is held out to him, and section of the affected nerve is not unfrequently recommended as a last chance of the removal of the disease. It is clear, however, that such an operation, though occasionally productive of temporary relief, cannot in many cases be expected to benefit the patient materially; for by it the cause of the neuralgia is not removed, and it can consequently only be of service when the pain is peripheral, occasioned by some local irritation existing between the part cut and the terminal branches of the nerve. If dependent on any central cause, or on local irritation existing higher up than the point divided, it must eventually be useless. Thus, if the source of irritation exist in the dental branches of the infra-orbital, the division of this trunk might be useful; but if the pain be occasioned by any pressure to which this

nerve may be subjected in its passage through its canal by a carious state of the bones, or by disease of the periosteum, it would be unavailing; though it is a remarkable fact that it not unfrequently happens after these operations that there is a temporary cessation in the pain for a few weeks or months. In some of these cases, however, the pain shifts its seat from the branch operated on to another division of the same trunk; thus, if the infra-orbital be divided, the submental becomes the seat of pain. Or this may ascend, as it were, to the point at which the nerve was divided; as, in amputation for neuralgia of the knee, the pain may return to the stump, and again when this is removed a second or even third time.

The nerves on which this operation has been most frequently performed are the infra-orbital and the submental. Should it ever be thought necessary to do it, it would be proper not only to divide the nerve but to excise a portion of it, otherwise reunion will speedily take place, and the continuity of the nerve being re-established the operation will fail. The procedure simply consists in cutting down on the trunk where it escapes from the foramen, isolating and dissecting out a portion of it; in doing this, no great difficulty can be experienced by any one possessing moderate anatomical knowledge.

[In a recently published paper Dr. Carnochan, of New York, strongly advocates the performance of a novel operation for the cure of aggravated cases of tic-douloureux of the face, or neuralgia of the second branch of the fifth pair of nerves. He believes that in such cases the "key of the operation is the removal of the ganglion of Meckel, or its insulation from the encephalon." In the operations which he reports, Dr. Carnochan, after making free incisions on the face, perforated both the anterior and posterior walls of the antrum, and removed the ganglion of Meckel from its position in the spheno-maxillary fossa. He at the same time exsected a portion of the superior maxillary nerve an inch and three quarters, or two inches in length, dividing the trunk of the nerve across, immediately below the foramen rotundum.

The examination of the portion of nerve removed, in every instance revealed similar appearances. The trunk was thickened, vascular, and enlarged; the neurilemma and nerve proper being alike affected. The result of the three operations reported was satisfactory in the highest degree; no unfavorable consequences followed, and the patients were completely relieved of their agonizing complaint.

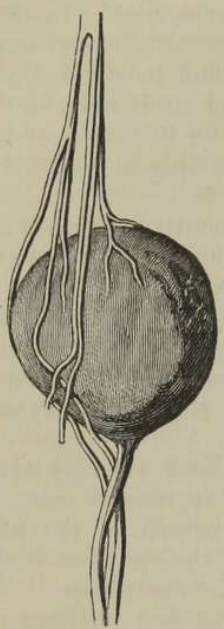
An operation somewhat similar to the above has been repeatedly and successfully performed by American surgeons for the excision of the inferior dental branch of the lower maxillary nerve. To effect this an incision should be made over the perpendicular ramus of the lower jaw, and the masseter muscle divided in the direction of its fibres down to the bone. The crown of a trephine should then be applied upon the bone at a point immediately below the entrance of the nerve into the dental canal. The trunk of the nerve to the extent of half an inch or more in length may thus be easily exposed and removed. The relief afforded to the patient has, as far as we are aware, in every case been prompt and enduring.]

NEUROMA.

By *neuroma* is meant a tumor connected with a nerve. These growths have been well described by Mr. R. W. Smith, in a recent Monograph on the subject, in which, indeed, the principal part of our knowledge of this subject is contained. These tumors vary in size from a millet-seed to that of a melon, are usually solid, and composed of fibrous tissue, but when they attain a large bulk, cavities may form in them, containing a yellowish or brownish serous-looking fluid, apparently owing to the disintegration of the central portions of the mass. In shape they are

usually oval or oblong, their long axis corresponding to the course of the nerve (fig. 198); they grow slowly, and are movable transversely, but not in the direction of the nervous trunk on which they are seated; they have no appearance of malignancy, and however large they become never contract adhesions to the integument nor involve its structure. These tumors commonly only affect the nerves of the spinal system, but Bérard has met with one case of the disease on a ganglionic nerve.

Fig. 198.



Most commonly the tumors are single, and then are usually attended with very severe lancinating or neuralgic pain, which extends, however, only to the parts below the tumor, and is commonly of a paroxysmal character. This pain is evidently owing to the stretching of the nervous twigs as they pass along the convexity of the growth. When single and painful, these tumors commonly go by the name of the *painful subcutaneous tubercle*, and are then usually met with from the size of a pin's head to that of a cherry-stone, commonly seated upon the limbs, and most frequently in connection with the nerves of the lower extremity; but they may be situated upon the arm, the trunk, or even on the scrotum and cheek, where, however, they are not so commonly met with. Wherever they occur they are acutely and intolerably painful on being touched, and are usually tender as well.

In structure, the painful subcutaneous tubercle resembles exactly the ordinary neuromatous tumor, being composed of a white or greyish fibrous mass developed in the neurilemma, and having nervous filaments stretched through or over it. The nervous trunk above and below the tumor is normal; it is only where it comes in contact with it, and is exposed to its pressure, that it undergoes the change indicated. It is a very remarkable fact, that though neuromatous tumors when single, or when but two or three exist, are most acutely painful, yet, that when they are generally diffused over the body they lose their sensibility and are unattended by any inconvenience, except such as arises from their numbers and bulk. The number of these masses thus formed is often amazingly great; thus, in one of Mr. Smith's cases, he counted in the two lower extremities alone more than 250 of these tumors, besides those in other parts of the body. In another case related by Mr. Smith, there were upwards of 200 small neuromata scattered over the sides of the chest and abdomen, 450 on the right lower extremity, and upwards of 300 on the left, altogether probably not less than 2000 of these growths in "this unprecedented case."

Traumatic neuromata may arise from the wound, or partial division of nerves, and occasion the most intense agony. Sometimes growths of this description of a fusiform shape, and varying from a cherry-stone to a pigeon's egg in size, are met with in stumps after amputations; in many instances unattended by inconvenience, but occasionally giving rise to a very severe degree of pain.

The *treatment* of painful neuromata whether of an idiopathic, or traumatic character, or existing in stumps, consists in their excision. After removal, the part supplied by the nerve, which is usually necessarily divided, becomes paralyzed for a time, but may eventually regain its sensibility. In some cases, however, by cautious dissection, the tumor may be removed from the nerve that is in contact with it, without cutting this across. This has been done by Velpeau in the case of a neuroma of the sciatic nerve. When these tumors are numerous, they should not be interfered with, and if unattended by pain, they need not be excised unless their bulk prove inconvenient.

TETANUS.

Tetanus is a disease consisting essentially in an excited state of the spinal cord and the medulla oblongata, in fact of the whole true spinal system, giving rise to painful and continued spasms of the voluntary muscles and the diaphragm, alternating with incomplete relaxation and usually terminating fatally. This, which is one of the most serious and distressing diseases to which the nervous system is liable, is, in the great majority of instances, of a *traumatic* nature, being the consequence of some wound that implicates or irritates a portion of the peripheral nervous system; the local irritation so produced, being propagated to, and exciting the nervous centres, the excitation of which becomes persistent, and continues after the local cause has been removed, inducing reflex muscular movements in various parts of the body. The irritation of the nervous system, however, that induces tetanus, may arise from other sources besides surgical wounds, occasioning the *idiopathic* form of the disease; thus, for instance, the presence of worms in the intestinal canal, exposure to cold and wet, and even the uterine irritation following abortion, have been known to occasion it. These causes, however, rarely give rise to it in this country, and we must consequently regard it as a disease chiefly arising from traumatic lesion of some kind.

Tetanus may be occasioned by injuries that do not give rise to breach of surface; thus I have known it occur in a child who was suddenly thrown down upon its back by another at play; and Dr. Reid mentions a case produced by the stroke of a whip. But certainly in the great majority of cases, it is directly occasioned by a wound of some kind; and then it will generally be found that a nervous twig has been lacerated, divided, or inflamed, thus in a case of tetanus following a wound of the knee, in a patient, who died in University College Hospital, a small branch of the internal cutaneous nerve was found to have been injured and was inflamed; and, in another patient who died of tetanus about sixteen days after treading on a rusty nail, a black speck was found in the internal plantar nerve, where it had been wounded by the nail. In another case under my care, in which tetanus resulted from a bruise of the back, and terminated in death, the injured nerve (a dorsal branch) was found lying bare and reddened in the wound, and on tracing it up to the spinal cord, its sheath was found to be much injured, ecchymosed, and with a large vessel running down it.

The kind of wound, as well as its situation, doubtless influences materially the occurrence of the disease. Though it certainly more frequently follows punctured, torn, and lacerated, than clean-cut wounds, yet it occasionally complicates these, even when the result of surgical operations; thus, it has been known to follow the removal of the breast, amputations, the ligature of the larger arteries, and the operation for hernia. It is the common belief, both in the profession and out of it, that wounds of the hands and feet, and more especially of the ball of the thumb and of the great toe, are more likely to be followed by tetanus than those in other situations. I think the truth of this opinion may be doubted; though it is not improbable that tetanus may occur more frequently after injuries of these regions, simply because punctured and lacerated wounds are more common here than elsewhere. It cannot well be supposed to be owing to the tendons and fascia that abound here, as it is seldom, if ever, met with after operations for tenotomy, which are so commonly practised on the feet.

Tetanus is especially apt to occur in feeble and debilitated individuals, and, indeed, may be looked upon as a disease of debility; hence any condition that lowers the tone of the nervous system is especially likely to occasion it. Thus, in unhealthy tropical climates, as in some of the West India Islands, and amongst the marshes of Cayenne, it is said to occur with peculiar frequency, the most trifling scratches or punctures being followed by the disease. The

exposure also of the wounded on the field of battle to cold, wet, and night air, is especially liable to occasion it. Thus, after the battle of Bautzen, where the wounded were left on the field during the night, exposed to severe cold, Larrey found on the following morning that more than one hundred were affected by tetanus. It may occur at all ages, but I believe is most frequently met with at the early and advanced periods of life. I have at least most commonly seen it either in very young or in old people; most frequently, certainly, in the young. In this country it rarely occurs amongst infants, but in hot climates it is said not unfrequently to be met with shortly after birth, from the irritation occasioned by the ligature of the umbilical cord.

Tetanus at times appears to occur epidemically. No case may occur in a hospital for a year or two, and then several will happen at or about the same time. This I have often observed.

Tetanus may take place at any period after the infliction of the wound that occasions it. In hot climates especially it may occur very speedily; thus, Dr. Robinson relates the case of a negro servant in the West Indies, who scratched his finger with a broken plate, and died of tetanus in a quarter of an hour. It is very seldom, however, in temperate climates, that it supervenes before the fourth or fifth day. Larrey, who had great experience of this disease during Napoleon's campaigns in Egypt, met with it most frequently between the fifth and fifteenth days after the infliction of the wound. According to the experience of the surgeons of the Peninsular War, under whose observation many hundred cases came, the disease does not show itself after the twenty-second day; but though this may be the general rule, Sir G. Blane has related a case in which it took place as late as a month after the infliction of the wound. It is stated that it may occur after the cicatrization of a wound is completed; when this happens the disease must rather be looked upon as being of an idiopathic character, accidentally occurring in a person who has been recently injured.

Tetanus may be *acute* or *chronic*, being in some instances fatal in the course of a few hours, but usually lasting for several days. If the patient survive this time, the disease will commonly run on to the eighth or tenth day, and occasionally even for a longer period than this; thus, S. Cooper mentions a case in which it continued in a soldier for five weeks after amputation. As a general rule, the more acute the case, the more dangerous is the disease. In chronic cases there is good hope of the patient's recovery.

Symptoms. — The invasion of the disease is often preceded by a general uneasiness on the part of the patient, a sensation of fear, or a sense of impending mischief. Abernethy was of opinion that tetanus was usually ushered in by a disturbed state of the digestive organs, the stools being offensive, and indicative of much gastric irritation. When the disease sets in gradually, it may be somewhat difficult of recognition in its early stages; if it comes on suddenly, its nature is immediately evident. It is a remarkable fact that the cramps do not begin in the parts injured; but, wherever this may be situated, they are always first noticed in the muscles supplied by the portio dura of the seventh; and throughout, it is principally these and the muscles of respiration that are affected. The first symptoms usually consist in the patient being unable to open his mouth widely, to take food or drink, the muscles about the temples, jaw, and neck, feeling stiff and rigid; this condition has given to the disease the popular term of *lock-jaw*. As the affection advances, the countenance assumes a peculiar expression of pain and anguish, the features are fixed or convulsed from time to time, and the angles of the mouth drawn up, constituting the appearance called the "risus sardonicus." When fairly set in, the disease is marked by spasms of the voluntary muscles of the most violent character, with much pain and partial remissions. The pain is of that kind that attends ordinary cramp in the muscles, as of the legs, and

is usually very severe. The spasms are often of a jerking character, the patient being suddenly thrown up, or twisted on one side; the breath being drawn with a loud sobbing catch from spasm of the diaphragm, and from the same cause there is usually violent pain experienced in the epigastric region, darting across to the spine. The muscles of the trunk are usually affected next in order of frequency to those of the head and neck, the body being bent backwards so as to form a complete arch; more rarely it is drawn forwards, and still less frequently to one side. In some cases the body becomes perfectly rigid, like a piece of wood, the belly being drawn in, and the chest expanded. It is said that in severe cases the spasms have been of so violent a character, the muscles have been ruptured, teeth broken, and the tongue lacerated. In the numerous cases of tetanus that I have unfortunately witnessed, it has never fallen to my lot to see any effects of this kind produced, the spasms, indeed, not in general being of a very violent, though of a continuous, and very painful character.

The intellectual faculties are not disturbed in these cases, and the mind continues clear to the last. In most instances there is a good deal of heat of surface, and quickness of pulse, not from any febrile disturbance, for this disease is unattended by symptoms of pyrexia, but apparently simply from the violence of the muscular contractions. The prolongation of life appears to depend greatly upon the intensity of the convulsive movements: the more severe these are, the sooner does death result. The fatal termination occurs not so much from any great physical lesion, or disturbance of important parts, as from exhaustion, consequent on the frequency of the tetanic spasms.

The morbid appearances found after death throw little light on the nature of this affection. Indeed, the only morbid condition that is constantly found, is a degree of inflammation of a nervous twig leading from and implicated in the wound, that has occasioned the disease. This morbid state I have never found wanting. In all cases of fatal tetanus that I have seen in which a careful dissection has been made, these signs of inflammation of a nerve communicating with the wound have been found, and the vascularity, which is often very intense, may be traced up the neurilemma often to a considerable distance; besides this, there is usually a degree of congestion of the brain and spinal cord, with some bloody fluid in the ventricles and in the subarachnoid space. Nothing in any way of a special character has been revealed by these investigations, which, as yet, have not elucidated the true nature of tetanus, any more than that of many other nervous diseases, such as hysteria and chorea.

The *treatment of tetanus* is of a local and of a constitutional character. The local treatment has for its object the removal of the irritation that has induced the tetanic condition. It is true that when once tetanic excitement has been set up in the cord it has a tendency to continue, and cannot be removed by the mere abstraction or cessation of the local irritation that gave rise to it in the first instance. It is, however, only reasonable to suppose that other treatment will succeed best if local irritation be removed, and, indeed, so long as this continues to keep up the centric nervous disturbance, no general means can be expected to succeed; as they will have not only to combat already existing disease, but also to overcome the continuous excitement maintained by the local disturbance. Hence, it is of use to get the wound into as healthy a state as possible, and to see that it is clean, free from foreign bodies, and not inflamed. In order effectually to remove all local disturbance, amputation has been had recourse to, but though this may have succeeded in checking some of the more chronic forms of the disease, yet other and milder local means have sufficed equally well, and in the majority of cases it has had no effect, and hence so severe an operation can scarcely be recommended for adoption. The division of the injured nerve, if there be one that has been punctured or lacerated, has occasionally proved successful. Thus, in a case of tetanus following injury of

the supra-orbital nerve, Larrey cut this across, and the patient was cured. In a midshipman, in whom tetanus came on the day after the sole of the foot had been wounded by treading on a rusty nail, Murray divided the posterior tibial nerve, and thus cured the patient. In those cases in which no special nerve appears to have been injured, Liston's recommendation of making a ∧ shaped incision down to the bone, and above the part, so as to insulate it completely, may be advantageously followed. After the nerve has been divided, or the part properly insulated, some solution of atropine may be applied to it, so as still further to lessen local irritation.

In the *constitutional treatment* of the disease, it is necessary to bear in mind that tetanus is an affection of debility, the violence of the spasmodic paroxysms giving an appearance of false strength to the patient, and that the principal source of danger and death is from fatigue induced by the energy of the muscular movements and the consequent want of rest. The means adopted should, therefore, have for their object the removal of irritation and the support of the patient's strength, to enable him to hold up against the disease.

The first thing to be done is to clear the bowels well out with a dose of calomel and scammony, or a drop of croton oil, aided, if necessary, by turpentine enemata. The patient should then be kept perfectly quiet in a room by himself, a screen, or muslin curtains, as recommended by Dr. Marshall Hall, being drawn round the bed: noise or movement of any kind increasing the spasms greatly. With the view of allaying the spinal irritation, the most effectual means consist perhaps in the plan recommended by Dr. Todd, of applying an ox's gut or gullet filled with ice along the whole length of the spine. This is a powerful depressing agent, and, unless care be taken, may lower the heart's action too much, or indeed completely extinguish it. It may, however, be applied with safety for six, eight, or ten hours, the condition of the patient being looked to in the meanwhile. Sedative or antispasmodic agents are seldom of much service. I have seen many drugs of this kind employed, without producing any material effect in lessening the violence of the convulsions. In some cases, however, the inhalation of ether and chloroform materially lessens their severity and gives the patient temporary ease; and there are instances on record from which it would appear that these agents have occasionally effected a cure. Mr. Miller speaks highly of the cannabis indica pushed to narcotism, 3 grains of the extract, or 30 minims of the tincture being given every half hour or hour. In one case, at Dr. Garrod's suggestion, I tried atropine endermically on a blistered surface, and gave conium internally in large doses, and although the patient, an old man, eventually died exhausted, yet these agents appeared to exercise a marked influence in diminishing the violence of the spasms, and I should be induced to attach much importance to their administration. Dr. Elliotson has spoken highly of the preparations of iron, especially of the carbonate, in these cases. At the same time that measures such as these are had recourse to, it must not be forgotten that the disease is one of great exhaustion, and that the patient will die worn out, unless he be supplied with plenty of nourishment. Beef-tea and wine should, therefore, be administered by the mouth, and nutritious enemata by the rectum, and in this way the powers of life may be supported until the violence of the disease expends itself. In the more acute forms of tetanus all remedies appear to fail, the patient speedily being destroyed by the disease. In the subacute or chronic varieties recovery may take place, and it is in these cases that sedatives, such as conium and cannabis indica, have been of use. I am, however, disposed to think that in these chronic cases much may be done by simple, and little by specific treatment — clearing out the bowels by turpentine enemata, the internal administration of calomel with some sedative, and keeping up the powers of the system till the disease wears itself out.

DISEASES OF THE ORGANS OF LOCOMOTION.

CHAPTER XLI.

DISEASES OF BONES.

PERIOSTITIS.

Inflammation of the periosteum is of common occurrence, as the result of injuries, as a consequence of syphilis and rheumatism, or as a natural process dependent on disease of the subjacent bone. It often affects the membrane covering the shaft of a bone, and very commonly attacks the articular end, becoming associated with inflammation of the contiguous joint. When acute, the membrane becomes thickened, soft, and vascular, and loosens from the subjacent bone. When chronically inflamed, the periosteum becomes thickened by the deposit of plastic matter within and beneath it, and the subjacent bone usually participates in the changes, undergoing hypertrophy and induration. In some cases, but rarely, suppuration and death of the layer of bone immediately subjacent to the affected membrane take place.

The *symptoms* of periostitis consist of a hard but somewhat puffy swelling, not distinctly circumscribed, and attended by much pain in the part, especially at night, with tenderness on pressure.

In the *treatment* of the acute form of the affection, the free application of leeches, with hot fomentations, and the exhibition of calomel and opium, will arrest the disease, and give relief to the patient. In the more chronic form, the continued administration of the iodide of potass will take down the swelling, remove the nocturnal pains, and materially improve the local condition of the part. Added to this, the occasional application of leeches and repeated blistering will be of essential service. If there is much thickening, considerable relief will be afforded by the free division of the periosteum down to the bone, either through the skin or by means of a tenotome slid under it.

OSTEITIS.

Inflammation of bone may arise from the same constitutional causes as the preceding disease, but most commonly occurs as the result of injury, either accidental or inflicted by the surgeon in an operation. When a portion of bone is inflamed, the periosteum and medullary membrane participate in the morbid action, and, together with the affected osseous structure, becomes highly vascular; at the same time the inflamed bone becomes expanded and softened, partly in consequence of changes induced in its organic constituents, and partly in consequence of the cancellated structure becoming more cellular from interstitial absorption; the cells becoming filled with a sero-sanguineous fluid. The compact structure of inflamed bone undergoes a peculiar kind of laminated expansion, so that a section of it presents an appearance of concentric parallel layers. When the inflammation is chronic, the bone is likewise expanded, but instead of becoming looser in its texture and softened, as in the acute form of the disease, it becomes very dense, indurated, and compact; looking and cutting more like ivory than ordinary bone. Sometimes considerable elongation, without much or any thickening, will take place. I have seen as the result of chronic osteitis the tibia one and a half to two inches longer than its fellow.

The *symptoms* of osteitis consist of enlargement of the affected bone, with deep-seated pain and great tenderness in the limb; the pain, as in periostitis, is greatly increased at night, and, when the disease is chronic, is much influenced by the state of the weather.

In the *treatment* of the acute cases, our principal reliance must be on local leeching, with calomel and opium; in the more chronic form of the affection, when the bone has become thickened and enlarged, nothing of a curative kind can be adopted, and the only remedy consists in the administration of iodide of potass for the relief of the pain, with perhaps the occasional application of leeches. After a time, when all morbid action ceases, the hypertrophied bone does not give rise to any very serious inconvenience, except such perhaps as may be occasioned by its bulk.

Osteitis is principally of importance to the surgeon from its connection with other more serious diseases of bones, in which it not unfrequently terminates. These conditions are suppuration of the bone, its ulceration, caries, and necrosis.

SUPPURATION OF BONE.

Suppuration of bone may occur in two forms, the acute and the chronic. The acute form of suppuration (*osteo-pyelitis*) is invariably of a diffused character. It usually arises as the result of injury inflicted on bones in operations, as for instance in amputations, or the excision of joints, but sometimes occurs in connection with compound fractures. In it, the medullary membrane is primarily affected, the inflammation rapidly extending through the whole of the medullary canal and adjoining cancellous structure, which speedily becomes filled with pus. Mr. Stanley observes that the medullary membrane in this disease becomes vascular like the conjunctiva in chemosis, and is often black and gangrenous (*osteo-myelitis*). This purulent infiltration of the interior of the bone is very apt to give rise to phlebitis and pyemia, and hence becomes a most formidable affection, the pus finding its way into the veins of the bone, and from thence into the general current of the circulation. Osteo-pyelitis, phlebitis, and pyemia constitute a pathological sequence that is by no means an uncommon cause of death after operations implicating the medullary canal. When the diploe of the skull is affected, the sinuses and cerebral veins may be found after death highly inflamed and filled with pus. In a case in which I excised the elbow-joint, the patient died of pyemia, and after death the interior of the humerus was found to be inflamed and filled with pus, and the axillary vein in a state of suppuration (fig. 199).

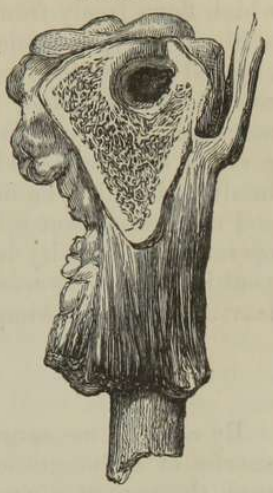
Fig. 199.

The invasion of this disease, after an operation, is indicated by great and deep-seated pain, with much swelling, tension, œdema, and general redness of the limb or stump. The wound becomes sloughy, all discharge from it ceasing, rigors occur, and the symptoms of pyemia speedily set in. The treatment must be directed to the constitutional condition induced by the affection.

The more chronic form of suppuration of bone usually assumes a circumscribed character, and leads to the formation of abscess. These abscesses are usually met with in the cancellated structure, and occur with especial frequency in the head and lower end of the tibia. In some instances they are tolerably rapid in their formation, but in the majority of cases are excessively chronic. When of a more acute character, they are probably the result of the softening of tubercle previously deposited in the bone; and forming in the cancellous

structure, are very apt to undermine the contiguous cartilage of incrustation and eventually to burst into the neighboring joint (fig. 200). When of a more chronic character, they are usually of very small size, and are deeply seated in the substance of the head, or in the medullary canal of the bone; the osseous substance covering them having long been the seat of chronic inflammation, becomes greatly thickened and indurated. Most commonly the quantity of pus contained in these abscesses is extremely small, and it is often mixed with cheesy or tuberculous matter, or contains portions of necrosed bone intermingled with it. In some cases, however, Mr. Stanley has observed that abscesses of bone are large, containing a considerable quantity of fluid.

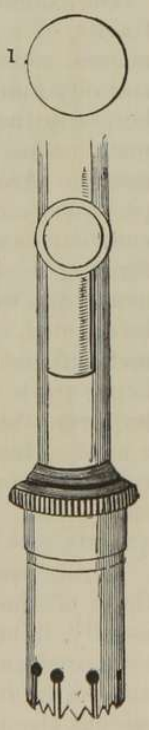
Fig. 200.



Abscess in the head of the Tibia.

The *symptoms* of chronic abscess of bone are usually of the following character. The patient, after the receipt of an injury, perhaps, has noticed that at one spot the affected bone has become swollen and painful; the skin covering it preserving its natural color in the majority of cases, but in some instances becoming red, glazed, and œdematous; the pain, which is of a lancinating and aching character is usually remittent, often ceasing for days, weeks, or months, and then returning under the influence of very trivial causes, with its original severity. It is especially troublesome at night, and is always associated with a degree of tenderness of the part; and indeed, in the intervals of its accession, it will be found on careful examination that there is always one tender spot in the enlarged and indurated bone. The persistence of these signs will usually point to the existence of a small circumscribed abscess under the thickened wall of the bone. But it must be borne in mind that the same local symptoms may be induced by the presence of a small portion of dead bone confined within an impervious casing, or even that they may arise from the simple pressure of osseous structure, thickened by chronic inflammation. For all practical purposes the diagnosis is of little consequence, as the treatment is the same, whether the pain and other symptoms arise from the confinement of a few drops of pus, the inclusion of necrosed bone, or the pressure of the hypertrophied osseous tissue.

Fig. 201.



The proper *treatment* of circumscribed abscess of bone has been pointed out by Brodie. It consists in trephining the bone with an instrument having a small crown, so as to make an aperture for the exit of the pus, of this size (fig. 201, 1). So soon as a vent has been given to this, which is often cheesy, and occasionally very offensive in its character, the patient will experience great and permanent relief. In performing this operation, there are several points that deserve special attention. The bone must be exposed by a T or V shaped incision, made over the spot which has been found to be uniformly tender on pressure; and to this the trephine should be applied. The trephine should have a small and deep crown of this size and shape (fig. 201), and it is well always to be provided with two instruments of the same shape and size that will exactly fit the same hole, lest one become disabled by the density and hardness of the osseous case that has to be perforated, as I have seen happen. When the trephine has penetrated to a sufficient depth, the button of bone may be removed

by means of an elevator; but care should be taken not to perforate the whole thickness of the bone. The diseased cavity will very commonly at once be opened in this way, a small quantity of pus escaping, which may, however, readily be overlooked, as it is carried away in streaks with the blood, which flows freely from the cut bone. Should no pus escape, perhaps a portion of dead bone, or some dark gritty masses of disorganized osseous tissue are exposed; if so, they must be removed with a gouge. But if neither of these conditions are found, the surgeon must not be disappointed, but pierce the neighboring osseous tissue in different directions by means of a perforator, when perhaps the abscess will be opened; should it not be so, the patient will still, in all probability, be materially benefitted by the removal of the circle of bone, and the consequent relief to the compression of the osseous tissue. After the operation, the cavity left must be dressed from the bottom with wet lint, and a poultice be afterwards applied; it will gradually fill up with fibrous tissue, leaving the limb unimpaired in utility and strength.

CARIES.

By *caries* some surgeons mean a kind of ulceration of bone; others, again, a species of disintegration of the osseous tissue; and Stanley includes under this term the various changes consequent on the chronic suppuration of the cancellous structure. But caries, I think, properly means a disease of the bone characterized by increased vascularity, softening, and ultimate disintegration of the osseous tissue. It appears to consist in a breaking down of the organized portion of the bone, in consequence of which the earthy matters become eliminated in a granular, molecular, and almost diffluent form in the pus formed by the inflammation of the surrounding more healthy structures.

On examining a portion of carious bone, it will be found to be porous and fragile, of a grey, brown, or blackish color; in parts broken down in softened masses, and at others hollowed out into cells, which contain a reddish-brown and oily fluid. The process of wasting which goes on in the bone, appears to be partly the result of ulceration, and partly of disintegration of its tissue. In many cases, small masses of dead bone lie loose and detached in the carious cavity. Around this carious portion, the bone, as well as the medullary and periosteal membranes, is usually extremely vascular; and, in many cases, hardened compact masses of osseous tissue will be found deposited around, or even forming the exterior wall of the carious cavity. These changes are most commonly met with in the cancellous structure, but the compact tissue may likewise be affected. As it so frequently occurs in the cancellated tissue, it is commonly met with in the heads of bones; and here the disease is extremely dangerous, being apt to undermine and destroy the contiguous articular cartilage, and thus implicate the joint. This caries of the articular ends of bones is consequently a most serious affection, and is a very frequent cause of incurable joint disease, such as suppuration and destruction of cartilage, followed perhaps by partial anchylosis. Any bone may be affected by caries, but it is perhaps more frequently met with in the short and cancellous bones.

Caries occurring in strumous constitutions, and affecting the short bones, as those of the tarsus, or the cancellated heads of the long bones, as the tibia, usually, if not always, commences in the centre of the bone, which becomes congested, softened, and disintegrated, in many cases without any external cause, but apparently simply from the diminution of vitality in those parts of the osseous structure which are farthest from the periosteum, and which do not, like the deeper structures of a long bone, receive a supply of blood from an internal or medullary membrane. In these cases, the inflammation of the soft investing parts, and the destruction of the joint, which usually ensues, is consecutive to the disease in the bone.

The *symptoms* indicative of the occurrence of caries are of a very equivocal character, and are not unfrequently, in the early stages, mistaken for those of ordinary phlegmonous abscess or rheumatism. They consist of pain in the bone, with a good deal of redness and swelling in the soft tissues covering it; abscess at last forms, often of considerable size, and on letting out the pus, the character of the disease will be recognized, as the bare and rough bone may be felt with a probe, which sinks into depressions upon its surface, which, though rough, yields readily to the pressure of the instrument. The cavity of the abscess gradually contracts, leaving fistulous openings, which discharge a fetid pus, usually dark and sanious, intermixed with granules of bone, and containing a superabundance of the phosphates. The fistulous openings are generally surrounded or concealed by high spongy granulations, and the neighboring skin is duskily inflamed. Caries usually occurs in constitutions that have been debilitated by struma or syphilis, often without any other apparent cause. In syphilitic constitutions it is apt, however, to affect the surface of the bone, disintegrating and eroding this in a remarkable manner. This condition has been described by Stanley as true *ulceration of bone*, and he regards it as distinct from caries, and analogous to ulcers of the soft parts. Here the disease does not penetrate deeply, but leaves the surface rough and porous, with a good dea. of inflammation in the soft parts around the affected bone. He states, that it only occurs in adults, and in males, and is very chronic in its character; it is met with primarily in the bones of the spine, but also occurs on the articular surfaces in advanced stages of joint-disease.

The *treatment* of caries must be conducted in reference to the constitutional cause that occasions it, the removal of which is the first and most essential element in effecting a cure. If it arise from syphilis, this must be eradicated; if from struma, the general health must be improved. By the removal of causes such as these, the disease will often cease spontaneously, and even undergo cure, more especially in young subjects. Hence, it is well not to be in too great hurry to interfere, by operative means, in the caries of the small bones of children. I have often seen cases, especially of caries of the bones of the hands and feet, in which an operation for the removal of carious bone was apparently indispensable, get well spontaneously by change of air, and attention to the general health of the child; the disintegrated particles of the diseased bone being eliminated piecemeal.

In the first stage of caries, which is inflammatory, measures should be taken by means of appropriate local and constitutional antiphlogistics to subdue the activity and limit the extension of the disease; and when this has fallen into a chronic stage, constitutional alteratives should be employed. Amongst these, cod-liver oil, the iodides, and change of air, more especially to the sea-side, when the patient is young, should hold the first place.

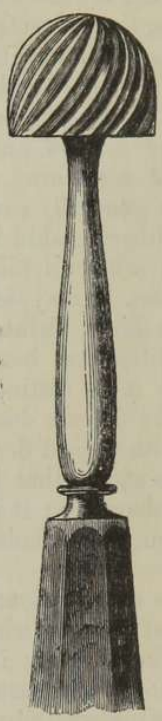
When, however, the disease has fallen into a chronic condition, and nature seems unable to eliminate the carious bone, all reparative action having ceased, or being inefficient for the restoration of the integrity of the part, an operation becomes necessary. When the operative procedure has reference to the diseased part itself, it is impossible to be too careful in delaying it until the acute stage of the disease has passed, and the inflammation in the bone and surrounding tissues has subsided into a chronic state. Unless this be done, the excited action set up by the operation will infallibly give fresh impetus to the disease, which will make more rapid progress, and may perhaps terminate in diffuse suppuration of the bone.

The operations practised upon carious bones are of three kinds; consisting either in simple removal of the diseased portion of bone; — in the excision of the carious articular end; — or, in the amputation of the whole of the bone affected.

The removal of the carious portion of bone is best effected by means of the

gouge. This instrument is especially useful in those cases in which short, thick bones, or the articular ends of the long bones, are affected, without the neighboring joints being implicated. In applying the gouge, the diseased portion of bone should be exposed by a crucial incision; and if necessary, its cavity opened by a small trephine. The gouge, fixed in a short, round handle is then freely applied, and the diseased tissues scooped and cut out. In order to do this efficiently it is desirable to be furnished with instruments of different shapes and sizes, so that there may be no difficulty in hollowing or cutting away every portion of bone that is implicated. I have found the *gouge-forceps* (fig. 207), a very useful addition to the gouge in clearing away angular fragments and projections of bone, and thus removing the whole of the diseased structures. In some cases Mr. Marshall's *osteotrite* (fig. 202) will be found a very serviceable instrument, clearing away the softened carious bone without risk to the surrounding healthy structures.

Fig. 202.



In removing the carious bone with these instruments, the surgeon may be sometimes at a loss to know when he has cut away enough. In this he may generally be guided by the difference of texture between the diseased and healthy bone; the former cutting soft and gritty, readily yielding before the instrument, whilst the latter is hard and resistant; so that when all the disease is removed the walls of the cavity left will be felt to be compact and smooth. In some cases it is true that the healthy bone may have been softened by inflammation; should there be any doubt as to the condition of what has been gouged out, it may be solved by putting the detritus into water, when, if carious, it will either wash white or black: whereas, if healthy, but inflamed, it will preserve its red tint. In operating on young children especially, it is well not to have the gouges too sharp, lest the inflamed, but otherwise healthy, though somewhat softened bone be cut away together with the disintegrated caries. The cavity that is left should be lightly dressed from the bottom, and allowed to heal by granulation, when it will gradually fill up by fibrous material deposited in it.

When the caries affects the articular ends of the bones, as those that enter into the formation of the elbow or shoulder-joints, it may be so situated as not to admit of removal in the way just indicated, but to require excision of the diseased articulation: these operations we shall consider in a subsequent chapter. When the caries involves a bone so extensively that neither of the preceding plans can successfully be put into operation, it becomes necessary to remove the disease either by the resection of the whole of the bone, if it be of small size, or by the amputation of the limb, if of greater magnitude, or if it affect the neighboring joints extensively. Thus, for instance, resection of the os calcis may be required for caries of that bone, whilst if the whole of the tarsus is affected, amputation is the only resource.

In some cases of chronic disease of the tarsus, however, large portions of different bones may successfully be removed; and indeed I look upon these operations of gouging away and scraping out carious bones as preferable to the more formal operations of excision of special bones. In a case of very extended disease of the outer side of the ankle and foot, I removed three inches of the fibula, the greater part of the astragalus, the upper and outer part of the calcaneum, and the whole of the cuboid, leaving a large triangular cavity in the bones, which readily filled up, a most excellent limb resulting.

NECROSIS.

The transition from caries to necrosis is easy; caries may be regarded as the granular disintegration or molecular death of the osseous tissue, conjoined with suppuration of the surrounding healthy parts; whilst necrosis must be looked upon as the death of the osseous tissue as a whole, a condition indeed closely resembling that of gangrene of the soft parts. Whilst caries, however, chiefly affects the cancellous structures, necrosis is met with in the compact tissue of bone, and far more frequently occurs in the shafts than in the articular ends of the long bones. It is, however, occasionally found in the cancellous structure; thus in the head of the tibia, or in the os calcis, small masses of necrosed bone are not unfrequently found lying in the midst of carious or suppurating cavities. The different bones are affected by necrosis, with varying degrees of frequency. The tibia, at its anterior part is most frequently diseased; the femur in its lower third is also very commonly affected. The lower end of the humerus is not so often necrosed; but not uncommonly the phalanges of the fingers from whitlow, — the cranium from syphilis, — the lower jaw, from the emanations evolved in the manufacture of phosphorus matches, — and the clavicles and ulna, from injury or constitutional causes, are found affected by necrosis.

The *causes* of necrosis are of very various character. We have just seen that it is predisposed to by the structure of particular parts of bone, and is more frequent in some bones than in others:—amongst the more constitutional causes, we may rank in the first line those cachectic conditions of the system that result from scrofula and syphilis, and those debilitated states of constitution that so frequently follow upon typhus fever: in these various states, the bone may suddenly lose its vitality, more especially if the limb be subjected to slight accident, as concussion, or to exposure to some degree of cold. In some cases the disease results from the vitality of the bone being destroyed by the extension of inflammation to it from the neighboring tissues, as in some cases of whitlow, or by the bone becoming exposed by a neighboring abscess.

Traumatic causes frequently give rise to necrosis. Thus the denudation of a bone by its periosteum being stripped off, may lead to its death; but though the bone thus injured often loses its vitality, yet, if the membrane be replaced, its life may be preserved; or even when exposed, adhesions may take place between it and the neighboring soft parts, or granulations be thrown out by its surface, which eventually form another periosteum. Necrosis frequently occurs as the result of the detachment and denudation of a portion of bone in cases of bad compound fracture; so also the application of certain irritants, as the fumes of phosphorus, may occasion this disease, and hence it has occasionally been found that in lucifer-match manufactories, necrosis of the lower jaw is of frequent occurrence as a consequence of the acrid fumes that are eliminated getting access to the bone through carious teeth, or being applied to the exposed alveoli.

In whatever way it originates, the necrosis may affect the outer laminæ of the bone only, when it may be denominated *peripheral;* or the innermost layers that surround the medullary canal may perish, and then it may be termed *central;* or the whole thickness of a shaft, or of the substance of a short bone, may lose its vitality. The portion of bone that is necrosed, called the *sequestrum*, presents peculiar characters, by which its nature may at once be recognized. It is of a dirty yellowish-white color, and has a dull opaque look, and after exposure to the air, it gradually becomes of a deep brown or black tint; the margins are ragged, and more or less spiculated, and the free surface tolerably smooth, but its attached surface is very irregular, rough, and uneven, presenting an eroded or worm-eaten appearance. When the sequestrum forms in the cancellous structure, it is usually of a blackish-grey color, irregular but

somewhat ovoid in shape, as if the bony matter had been partially dissolved away, and here is frequently conjoined with caries of the surrounding bone.

The *symptoms* of necrosis are divisible into two distinct periods. In the first the bone dies and undergoes separation, and an attempt is made by nature at the expulsion of that portion of it which has lost its vitality. In the second period the reparative processes for the restoration of the proper length and shape of the shaft are carried on: the particular character of the symptoms depends however not only on the stage, but also in a great measure on the seat and extent of the necrosis. In all cases it is ushered in by symptoms of local inflammation of a more or less intense and painful character; the skin becoming glazed, œdematous, and of a purplish-red tint; abscess, often of large size, and discharging great quantities of fetid or bloody pus, forms in the limb, and burrows widely, in proportion to the extent of the necrosis, amongst its cellular planes. If the suppuration be not so extensive as to jeopardize life, as occasionally happens when the thigh is the seat of disease, the patient sinking into rapid hectic, the suppurating cavity will gradually contract, leaving fistulous and sinuous tracts, often of great length and extent, leading to rough and bare bone, discharging a fetid and ichorous pus, and having their orifices surrounded by protuberant and glazed granulations. All these symptoms of inflammation, abscess, and wide-spread suppuration, have for their ultimate objects the separation and elimination of the dead bone, and the proper formation of new bone, as a substitute for that which has died.

In the peripheral necrosis of the shafts of the long bones, as of the femur or tibia, the inflammatory symptoms just indicated are well marked, and the disease usually runs a rapid course up to the period of the formation and discharge of the abscess. In the case of central necrosis, the pain is usually more severe than in the former case, and is peculiarly deep-seated and throbbing, being especially intense at night. The limb becomes very œdematous, red, and glazed; the bone enlarges greatly, and abscess at last forms, which spreads widely in the planes of cellular tissue, undermining the muscles, and producing general destruction of the limb, the tissues of which become rigid and condensed, having sinuses leading down through them. On introducing a probe into these channels, the instrument passes through apertures in the bony case, termed *cloacæ* (fig. 203), at the bottom of which the dead bone will be felt rough and bare. Though this is the general condition that occurs in central necrosis, it occasionally, but rarely happens, that a small portion of some of the internal lamellæ of the bone dies, and being included in a greatly thickened case of new bone, gives rise to symptoms of osteitis, or closely resembling circumscribed abscess of bone, but not to those characterizing necrosis.

When the whole thickness of a shaft dies, the symptoms are always of a very acute kind, the extent and gravity of the inflammatory and suppurative condition being proportioned to that of the amount of bone that loses its vitality. It is a remarkable fact, however, that the articular ends usually escape, though these sometimes even become affected, and the joints involved. When the short cancellated bones or the articular ends of long bones, become the seat of necrosis, it commonly happens that the disease is far more chronic than in the cases described; abscess forming, which at first may not reveal its true nature, or being preceded by continual pain, may be looked upon as a disease of a rheumatic character. Suppuration at last occurs, sometimes rapidly opening into the neighboring joint, and disorganizing it with extreme constitutional disturbance, but more commonly it runs a very chronic course. On passing the probe down the fistulous openings that lead through the indurated and thickened soft parts, an aperture may usually be felt in the bone, at the bottom of which lies a necrosed mass not larger than a hazel-nut, surrounded by carious bone.

Acute necrosis often attacks the long bones, especially the tibia and femur.

In these cases violent and deep-seated pain occurs in the limb, which swells greatly Abscess soon forms along the whole line of bone; great constitutional disturbance ensues, and, unless the limb be amputated, death will usually speedily result. This form of necrosis chiefly occurs in young and cachectic subjects. On examination after removal, the bone will be found white, opaque, and dead-looking; the periosteum is detached, new bone is deposited, the surrounding parts infiltrated, and, usually, abscess around the bone to its whole length. In many cases the articular ends escape, the necrosis being confined to the shaft of the bone, which will be found to be detached from one or both epiphyses. To these the periosteum of the shaft, greatly thickened, will continue to be adherent, and would have formed the organ for the reproduction of the bone, had the limb admitted of being saved. In extreme cases, the articular ends even are involved, and the joints secondarily affected.

The *process of the separation* of the dead bone, and of the formation of a new osseous tissue to supply the place of that which is necrosed, is one of the most interesting phenomena that the surgeon can study. The separation of the dead bone, or its *exfoliation*, is precisely similar to the mode in which a slough in soft parts separates, the time required being the only difference. Inflammatory action is set up so as to form a true line of demarcation and of separation in the substance of the bone that is still living, and that is immediately contiguous to that which has lost its vitality. In this way a groove is gradually deepened around the edge of the sequestrum, by the absorption, or rather disintegration of the earthy matter of the living bone, which is carried off by the pus formed in the course of this process; pus that, according to B. Cooper, contains 2½ per cent. of phosphate of lime. Along this gradually deepening line of separation, plastic matter is thrown out, from which granulations are formed which constitute a barrier as it were between the living and dead bone, and extending into the under surface of the sequestrum, become so implanted in the hollows and depressures which are there found, that this may continue to be firmly attached to the subjacent living bone after all osseous connection between them has ceased. This process of exfoliation may often be beautifully seen in the separation of the outer table of the skull in cases of necrosis of that bone. When occurring between the shaft and articular ends of a long bone, the process is precisely similar, though the line of separation is not quite so regular.

When once the dead bone has been detached by the formation of this line of separation, nature adopts steps for its ultimate removal from the body, there being no evidence that it ever, under any circumstances, undergoes absorption. Miescher has shown that the detachment of small scales of bone may take place by the disintegration of their substance by a process of "insensible exfoliation," as he terms it. This process is a purely mechanical or physical one, and probably goes on in all dead bone that is in contact with pus, just as we see it take place in the ivory pegs used in the treatment of ununited fracture. It is this disintegration of the surface of the dead, together with the absorption of the margin of the living bone, in the formation of the line of separation, that explains the fact that the sequestrum will always be found to be of much smaller size than the cavity in which it is lodged. The ultimate expulsion of the loosened or exfoliated sequestrum is effected by the growth of the granulations below it pushing it off the surface, or out of the cavity in which it lies. When the necrosed bone is peripheral, it will be readily thrown off in this way, although it may for a time be fixed and entangled by the mere pressure and extension of the granulations. When the sequestrum is invaginated within old or new bone, the process of elimination is necessarily very tardy, and may be difficult or impossible without surgical aid. The time required for the exfoliation and separation of dead bone varies greatly. When superficial and small in size, a few weeks may suffice

but when affecting the long bones, or especially those of the ilium, the process may be extended over several years, and may terminate in the death of the patient from exhaustion before it is concluded; the constitution being harassed and worn out by hectic induced by profuse suppuration. Or the disease may fall into a chronic state, the limb becoming rigid, with much condensation of tissues, with fistulous apertures leading down to exposed but attached bone, and thus being a source of constant annoyance and suffering to the patient.

Fig. 203.

The *reparative process* adopted by nature for the restoration of the integrity of the bone, a portion of which has necrosed, varies according to the extent of the loss of substance. When the outer lamellæ alone are necrosed, new bone is deposited by the surrounding periosteum, and the depression that has formed on the surface of the old bone is filled up by a kind of cicatricial fibrous tissue, which ultimately ossifies. If the whole of the inner lamellæ of the shaft die, constituting central necrosis, the outer layers of bone become greatly consolidated and thickened by osseous matter deposited from the periosteum, in which, in the majority of cases, the circular or oval apertures termed *cloacæ* form for the ultimate extrusion of the sequestrum (fig. 203.) In some cases, however, no cloacæ form, the dead bone continuing to be incased in the thickened outer layers. When the whole of a shaft dies, the reproduction takes place from various sources, principally from the periosteum, and perhaps the medullary membrane, if that is left, which become thickened, vascular, and detached from the necrosed bone. That the periosteum takes the principal share in the reproduction is evident from the fact that where it is deficient or has been destroyed, apertures (*cloacæ*) are left in the case of new bone. Then again the soft tissues of the limb generally, if thick, as in the thigh, contribute to the formation of plastic matter, which gradually ossifies, and so tends to strengthen the new case; and, lastly, the articular ends of the old bone still preserving their vitality, throw out sufficient osseous matter to consolidate themselves firmly to the new shaft that is formed. Thus it will be seen that the new bone is formed by the vascular and healthy tissues generally that surround the seat of disease, though in this reparative action the periosteum and medullary membrane take the chief share. In acute necrosis there is no time for reparative action to take place, but the periosteum will be found much thickened and vascular, separated from the dead bone, and occasionally lined with scales of new ossific matter, the first step towards the reproduction of a new shaft.

The new bone which is deposited on those parts of the surface of the shaft from which scales of the old osseous tissue have been separated, or that envelopes the sequestrum when the whole thickness of the shaft necroses, is at first rough, porous, cancellated, and very vascular; after a time it gradually becomes more compact and harder, at the same time that it assimilates in bulk and shape to the bone, whose place it takes. When the new bone is deposited around the sequestra so as to envelope these in a kind of case, apertures of an oval or circular form, cloacæ, are formed in it; these serve for the escape of the discharges, and it is eventually through these that the dead bone is extended; they are said to correspond with points at which destruction of the periosteum has taken place. The case of new bone, which necessarily exceeds in circumference the old bone, as this is included within it, gradually contracts both in texture and in size, becoming firmer and smaller after the removal of the sequestrum; and

the cloacæ closing so soon as all dead bone has been extruded, it eventually acquires the proper size and shape of the bone; the medullary canal even becoming lined by a proper membrane forming in it.

The new bone usually forms with a rapidity that keeps pace with the death and separation of the old bone. In acute cases of necrosis in which amputation has been performed but a few weeks after the setting in of the disease, a thick layer of new bone will sometimes be found under the periosteum; but in some instances, when the whole of a shaft is necrosed, the new case is not completed, or has not become attached to the articular ends before these are separated from the shaft. In other cases again, though complete, it has not sufficient strength to resist the contractions of the muscles of the limb; under these circumstances, it may spontaneously fracture, as happened in a case of necrosis of the thigh lately under my care in the hospital, or become shortened or bent. In other instances again, when the periosteum is deficient, new bone does not form (fig. 204); but as the sequestrum separates, the limb becomes shortened, loose, deformed, and useless.

Fig. 204.

In the *treatment* of necrosis, the indications to be accomplished are sufficiently simple, though the mode in which they have to be carried out often requires much patience and skill on the part of the surgeon.

The first point to be attended to is to remove any constitutional or local cause that has occasioned or keeps up the disease; unless this be done, it is clear that the whole of the rest of the treatment must be ineffectual; thus, for instance, if the death of the bone appear to result from scrofula or spyhilis, those conditions must be corrected. So, again, if it arise in the lower jaw, from the fumes of phosphorus, the patient must necessarily be removed from their influence; or, if it be threatened in consequence of denudation of bone, the best mode of prevention will be to lay down the flaps of integument, and so cover the exposed surface.

After the cause has, in this way, been removed or counteracted, the separation of the sequestrum should be left, as much as possible, to the unaided efforts of nature. The less the surgeon interferes with this part of the process the better, for as has been justly observed by Wedemeyer, the boundaries of the necrosis are only known to nature, and the surgeon will most probably either not reach, or pass altogether beyond them. Here much patience will be required for many weeks or months, and the utmost that the surgeon can do is to attend to the state of the patient's health, treating him carefully upon general principles, removing inflammatory mischief, by appropriate antiphlogistic means, opening abscesses as they form in the limb, and, at a later period, supporting the patient's strength by good diet, tonics, and general treatment, calculated to bear him up against the depressing and wasting influence of continued suppuration, and of the irritation induced by the disease.

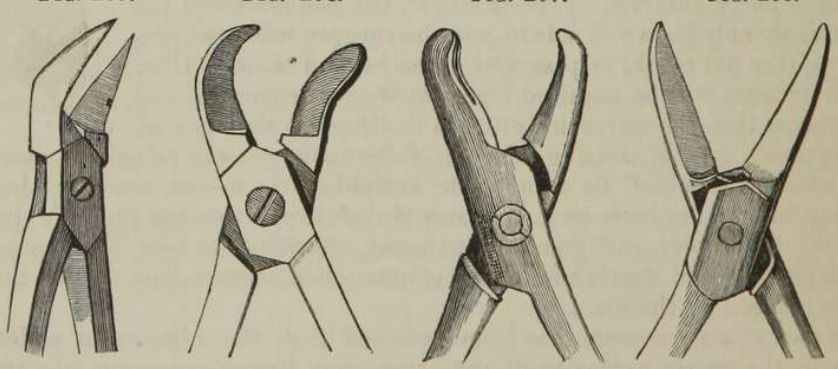
So soon as a sequestrum has been detached from the adjacent or underlying bone, by the proper extension of the granulating line of separation, the surgeon must proceed to its removal. In most cases it is sufficiently easy, when the necrosis is superficial, to ascertain that this separation has taken place, as the flat end of a probe may be pushed under the edge of the detached lamina. When, however, the sequestrum is deeply seated, it is not always so easy to ascertain that the separation has occurred, though, in the majority of cases, the introduction of a probe through one of the fistulous openings leading to the necrosed bone, and firm pressure exercised upon this, will enable the surgeon to

detect that degree of mobility which is characteristic of its being loose. In other cases, however, the sequestrum, though completely removed from all osseous connections, still continues to be fixed by the pressure of the surrounding granulations, and by the extension of its spiculæ into the corresponding cavities of the new osseous case. This especially happens when the necrosis is central and invaginated, and the cloacæ leading to it of such small size that but a limited portion of it is exposed. Here a more careful examination will be required, and its looseness may sometimes be determined by pressing upon it with a probe in a kind of jerking manner, or by introducing two probes through different cloacæ, at some distance from one another, and alternately bearing upon the exposed bone with one or other of them. Then, again, if the sound elicited by striking the end of the probe against the sequestrum, is a peculiarly hollow one, the detachment of the bone may be suspected. The duration of the disease, also, will probably throw some light upon the probable state of things inside the new case.

The separation of the sequestrum having been ascertained, the surgeon must adopt measures for its extraction. If the necrosis is peripheral, all that is necessary is to make an incision down to it through the soft parts, and then to remove it with a pair of forceps, or to tilt it off the bed of granulations on which it is lying, by introducing the end of an elevator beneath its edge.

When the necrosis is central, the sequestrum being imbedded in the new case, or covered in by old bone, the operative procedures for its removal are of a more complicated character. The difficulties here consist in the depth from the surface, and the obstacle offered by its passage through the soft parts in some cases, and in others, in the length and magnitude of the sequestrum in proportion to the small size of the cloacæ, and the manner in which it lies, in a parallel direction to these openings. In cutting down upon the bone the surgeon must be guided by the direction and the course of the fistulous tracks that lead to the principal apertures in the new case, the incisions being carried in the axis of the limb, and carefully directed away from large blood-vessels and nerves. In many instances, however, the hemorrhage is somewhat abundant, in consequence of the injected state of the tissues furnishing a copious supply of blood, and their rigid condition preventing retraction of the vessels; this, however, may be arrested by the pressure of an assistant's fingers, and will soon gradually cease of itself. The bone having been freely exposed, it will sometimes be found that

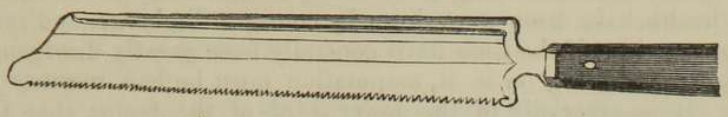
Fig. 205. Fig. 206. Fig. 207. Fig. 208.



the cloacæ are of sufficient size to admit of the ready extraction of the sequestrum. But in the majority of cases, this cannot be done at once, and the apertures must be enlarged, either with the gouge or the trephine, according to the density of the new case, and amount of room required. Occasionally, when two cloacæ are close to one another, the intervening bridge of bone may very conveniently be removed by means of cutting pliers, of different shapes, as in figs. 205, 206, and 208, or by means of a Hey's or a straight narrow saw (fig. 209), and space thus given for the extraction of the sequestrum. Very conve-

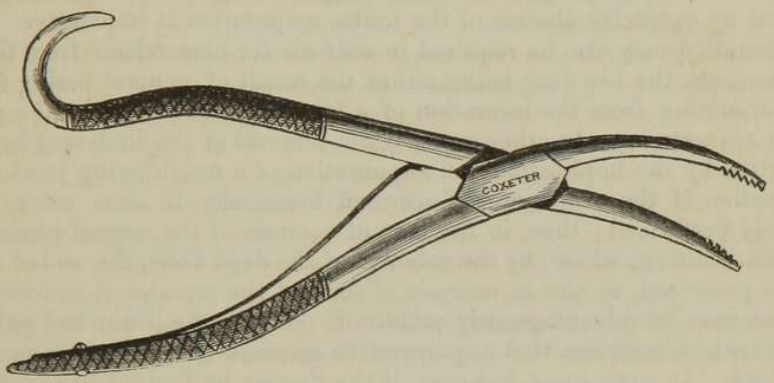
nient pliers, for this purpose, are those represented in fig. 207. They are made by Mr. Coxeter, with gouge ends, and hence may be termed *gouge-forceps*. I have found them extremely serviceable in many operations upon the bones.

Fig. 209.



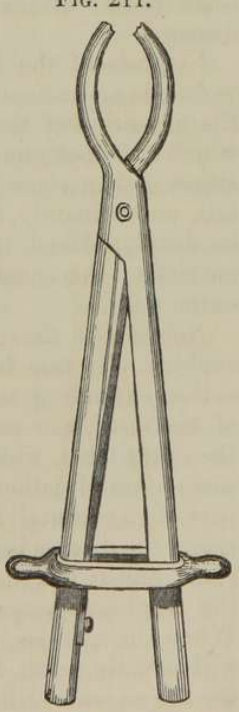
Care, however, should be taken not to remove more of the new case than is absolutely necessary, as the aperture so made in it will not be filled up again by osseous matter, but will be closed by fibrous tissue, and thus the ultimate

Fig. 210.



soundness of the limb might be endangered. For the extraction of the sequestrum the most convenient instrument is a pair of strong necrosis forceps, well roughened at their extremity, and straight or bent as the case may require (fig. 210). Occasionally the sequestrum is so shaped and placed that it cannot be seized with this instrument; under these circumstances, it will be useful to drive a screw-probe (fig. 56) into it, by which it may either be extracted, or so fixed as to admit of seizure, and removed by the forceps. In some cases, additional and convenient purchase may be given to the dead bone, by fixing a bone-forceps, such as represented in fig. 211, firmly into it. If the sequestrum is too large to be removed entire through the cloacæ, it may perhaps best be extracted piecemeal, having been previously divided by passing the points of narrow, but strong, cutting pliers into the interior of the bone. After the removal of the sequestra, a smooth, hollow cavity will be left in the new case, from the bottom and sides of which blood usually wells up freely, issuing abundantly from the vascular bone, and from the granulating membrane lining its interior. Should this hemorrhage be at all troublesome, pressure will always sufficiently arrest it. Lint must then be lightly introduced into the bottom of the wound and the part elevated; a good deal of inflammation is frequently set up after these operations, but that must be combated on general principles. If the sequestrum have been a long one, and involve the greater part of the shaft of the bone, it may happen that the new case has not sufficient strength to maintain the limb of its proper length and shape, and that it will bend or break under the action of the forces and weight to which it is subjected. In

Fig. 211.



order to prevent this accident, it will be necessary to put it up in light splints, or in a starch bandage. After the removal of the dead bone, the fistulæ will speedily close, and the limb eventually regain its normal size and shape.

If the necrosed bone be so situated that it cannot be removed, occupying too great an extent and continuing to be firmly fixed, and if, at the same time, the patient's health have been worn down by constant discharge, and symptoms of hectic come on; or, if the limb have generally been greatly disorganized by the morbid processes going on in it, amputation must be had recourse to as a last resource. It is especially in the lower third of the femur that these severe forms of necrosis occur, necessitating amputation of the limb. As an idiopathic disease, necrosis of the tibia is rarely met with requiring this operation, but when it is the result of bad compound fractures, or of other serious injuries, the removal of the limb may become imperative. In acute necrosis, however, of the lower end of the thigh or of the tibia, involving the contiguous joints and attended by extensive abscess of the limbs, amputation is imperative.

Amputation may also be required in necrosis for hemorrhage from the sinuses and abscesses, the bleeding being either the result of general oozing from their walls, or arising from the laceration of a large arterial trunk by the point of a rugged sequestrum. In other cases, again, removal of the limb may be rendered imperative by the implication and suppuration of a neighboring joint.

Resection of the whole of the necrosed bone may, in some cases, be advantageously performed; thus, in the case of necrosis of the ungual phalanx occurring from whitlow, where, by the removal of the dead bone, the end of the finger may be preserved, so also in necrosis of some of the metatarsal and tarsal bones, resection may be advantageously practised. When the ilium and pelvic bones are affected, it is seldom that any operative measure can be had recourse to with advantage. In some cases, however, if the disease be limited to a portion of the crest of the ilium, or to the tuber ischii, the dead bone may be removed. In these cases it, however, not uncommonly happens that disease of a similar kind exists elsewhere, about the sacrum or spine, that will eventually destroy the patient. In a case in which I removed a portion of the crista ilii for necrosis that was apparently confined to that bone, it was found, on the patient dying some weeks afterwards of erysipelas, that the lumbar vertebræ were also diseased.

Necrosis of the flat bones, such as the *sternum*, *scapula*, and *bones of the pelvis*, is an excessively tedious process, there being but very little tendency to the formation of the line of separation, and the detachment of the sequestrum, which will continue bare, rough, and adherent for many years. Should it be so situated that it can be removed, it must be excised, even though not detached; but, unfortunately, in the pelvis, it often happens that the necrosed portion is so deeply placed that it cannot be safely excised: here we must leave the patient to the chance of the bone being at length so loosened as to admit of extraction.

Necrosis of the *cranial bones* occurs as the result of injury, of scrofula, or syphilis. In this form of the disease there is the special danger of inflammatory action extending to the brain and its membranes. When attacking the vault of the skull, the necrosis is usually the result of syphilis, is often confined to the outer table, which may exfoliate in large plates, and is less liable than in some other situations to give rise to cerebral disease. When affecting the lower part of the frontal bone, the outer wall of the frontal sinus, or the supraorbital ridge, the disease is generally strumous, and the process of separation is extremely slow; and it will usually be necessary for the surgeon to remove, by means of the trephine, gouge, or cutting pliers, the attached, but rough and dead, bone. When the petrous portion of the temporal bone is the seat of necrosis, death will usually result from encephalitis. When the mastoid process is attacked, the sequestrum will often separate, and may be removed.

Necrosis may affect the alveolar process, the body or the ramus of the lower jaw. In these cases, the dead bone may usually, the separation having taken place, be extracted through the mouth without the necessity of incising the integuments covering it; but, when very extensive, it may require to be removed by external incision.

The *patella* is rarely necrosed. I have, however, met with one instance of primary necrosis of this bone leading to disorganization of the knee-joint, and necessitating amputation.

When the *ribs* are necrosed, abscesses and sinuses will often form to a considerable extent on the side of the chest. These must be laid open, and the diseased portion of bone scraped away by the gouge. In doing this, care must, of course, be taken that the adjacent intercostal space be not punctured by an unfortunate slip of the instrument,—an accident that is best avoided by protecting the gouge well with the finger.

CHAPTER XLII.

STRUCTURAL CHANGES IN BONE.

THE bones are liable to various structural changes, by which their size, shape, and consistence are modified, or in consequence of which they become the seat of tumors of various kinds.

Hypertrophy of bone usually results from inflammation of the osseous tissue, but in some cases it may occur apparently without having been preceded by any signs indicative of this condition; it then resembles in character some of the forms of exostosis that will presently be mentioned. *Atrophy* of bone sometimes occurs as a natural result, in old age. In other cases, again, it happens as a consequence of fracture, the nutritious artery of the bone, as has been pointed out by Mr. Curling, having been torn across, and one of the fragments consequently receiving insufficient vascular supply. Atrophy of bone also commonly occurs from disuse, as is the case in old dislocations. In cases of hypertrophy, the bone is not only enlarged in circumference, and also perhaps in length, but indurated, becoming specifically heavier. In atrophy, on the other hand, it is thinner, lighter, and more porous than usual, the compact structure disappearing, and the cancellous being expanded.

Rickets is a disease of early life, usually being met with in scrofulous children, and never occurring after the age of puberty. In it the structure of the bones is changed, the earthy matter being deficient and the organic material in excess, so that the bone continues to be soft, flexible, and cartilaginous in structure, at an age when its tissue ought to have undergone proper consolidation. It appears to be atrophied, and the cancellous structure to be expanded into cells of varying magnitude, which contain a brownish-red serous fluid. In consequence of the change of structure and the loss of firmness in the bones in this disease, considerable distortion of the body takes place. The head early appears large and expanded; indeed, Killian states that the rickets always first appear in the head, the forehead being especially protuberant; according to Mr. Stanley, this arises not from enlargement of the cranial bones, but in consequence of the want of development of those of the face; the head thus appearing large from its disproportion to the small face. The shape of the limbs is much changed and distorted, in consequence of their yielding to the pressure of the superincumbent weight; the pelvis becoming contracted, and the thighs and legs

bent either forwards or outwards. The joints are usually swollen, the articular ends of the bones appearing enlarged. In early life the chest will be observed to be deformed in a peculiar manner, being narrowed above, where the upper ribs are contracted and pressed in, but expanded below, apparently from the weight of the abdominal viscera, which are often tumefied, and in these cases drag on the lower ribs. As puberty advances, lateral curvature of the spine commonly takes place. In ricketty children there is a general delicacy of appearance, and often a strumous habit of body, though, according to Rokitansky, they are not usually tuberculous; if they live, however, past the age of puberty, they may eventually become sufficiently powerful in frame.

The *treatment* of rickets must be conducted on the same general principles that guide us in cases of scrofula; pure air, good food, and plenty of it, regular exercise, and the administration of tonics, especially the preparations of iron, with scrupulous attention to the general habits of life of the child, will generally improve his condition to the utmost limits compatible with the powers of his constitution, and by improving the nutrition of the system tend to the more healthy deposition of osseous matter. In some cases the administration of lime-water with milk seems to be of service in supplying those elements that are required by the system. It is of much importance in preventing deformity in these cases not to allow the child to walk or stand much, but to let it take exercise in donkey-panniers or hand-chairs, and to support those limbs that have a special tendency to become excurvated, with properly constructed steel supports, which will be found of much use, provided they are not too heavy, or interfere with the action of the muscles. Methodical friction should also be employed, so as to stimulate the muscles; as these become more vigorous, their osseous attachments have a tendency to become stronger.

Mollities and fragilitas ossium. Osteomalacia. — A very rare but most destructive and dangerous disease of the bones, characterized by softening and fragility of the osseous structure, is occasionally met with. This affection has of late years been studied with much attention by Curling, Solly, Stanley, and MacIntyre, and it is principally from the labors of these gentlemen that we are acquainted with its true pathology.

In this disease the bones are bent, their epiphyses swollen, and their shafts broken in various parts of the body. Occasionally, though very rarely, only one is fractured; but in other cases, as in Tyrrell's, there may be as many as twenty-two fractures; or, as in Arnott's, thirty-one. These fractures are unattended by any attempt at the formation of callus. The body becomes singularly and distressingly distorted. On examining the bones after death they will be found to be light, soft, and somewhat gritty; bending, and at the same time readily snapping across; occasionally they are expanded and thickened. This happens especially with the skull, which becomes often considerably increased in substance. On cutting the bones, which are soft, and yield something like cartilage, the knife usually encounters a kind of gritty sensation. On making a section of the bones they appear of a deep reddish-brown, or maroon color, and will be seen to contain cavities of various sizes, small or large, but always of a circular or oval shape, and generally filled with an oily, red, and grumous fluid; though sometimes they contain clear serum. On examining this red grumous matter under the microscope, Solly remarks that, as it shows a cell development, it is probably an adventitious morbid product, and not simply fatty matter altered by the effusion of blood into it; and Dalrymple has shown that this material is composed of granular matter, nucleated cells, and a few caudate corpuscles; he therefore believes it to be a disease essentially malignant in its nature, but differing from other malignant affections; for "instead of progressively reproducing and developing themselves without limitation, the new and morbid formations which replace the original and sound structure, seem to have been at an early age of their existence removed

by absorption and carried out of the system" (MacIntyre). The bone itself has been found by Solly on microscopical examination to have its laminated structure absorbed, the osseous corpuscles diminished in number, and the Haversian canals enormously distended.

In chemical composition the diseased bone has been found by Dr. Leeson to be composed of 18·75 animal matter, 29·17 phosphate and carbonate of lime, and 52·08 of water in every hundred parts.

The cause of the complaint seems altogether unknown; it would appear that in many cases it is connected with a rheumatic tendency, as in every case recorded, the affection has been preceded or accompanied by severe pains, or distinct rheumatic attacks. It most commonly, though not invariably, occurs in females, a fact pointed out by Killian, and exclusively attacks adults, commencing even at very advanced ages.

One of the most important points connected with this affection is the condition of the urine in it. In all cases that have been recorded, this excretion has been seen to contain large quantities of earthy matter. Solly pointed out that this is the phosphate of lime, which has been absorbed from the bone, and thrown out by the kidneys in the urine; and sometimes the elimination of these matters is so abundant that it forms, as in one of the cases which he relates, a solid calculus clogging up the interior of the kidney. In Dr. MacIntyre's case, the earthy matters of the bone appear to have been, in the first instance, absorbed, and carried off from the kidney by the urine, but afterwards an animal matter of a peculiar and apparently previously undescribed character, was discharged in great abundance. He says, that on adding nitric acid to the urine "a slight yellowish opacity was the first announcement of a change going on in the mixture; this gradually deepened in tint, with increasing consistency of the fluid, till the whole congealed into a bright and somewhat resplendent mass, presenting very much the appearance of a heap of nitrate of urea scales, blocking up the tube. It further resembled that substance in liquefying on the application of heat, and again concreting on cooling, but no crystalline arrangement could be perceived, the sparkling appearance being evidently due to numerous air-bubbles entangled in the mass. Perfect redissolution took place when the tube was held for a few minutes in the flame of a spirit-lamp, or plunged into hot water at 160° or 170°, the ordinary coagulating point of albumen; and the fluidity thus acquired persisted under ebullition, however prolonged." (Med. Chirurg. Trans. vol. xxxiii. p. 29.)

The symptoms of this disease are, in the early stages, of an extremely obscure and insidious character. The patient complains, in the first instance, of pains of a wandering character about the limbs and trunk; these assume usually a rheumatic character, though they have been observed to be of a much more severe, persistent, and intractable nature, than in any form of that affection. The patient becomes debilitated, unfitted for exertion, and emaciates. Spontaneous fracture now occurs in some bones under the influence of the most trivial causes; others become bent, and the body consequently greatly mis-shapen and distorted, occasionally in the most wonderful manner. The urine will be observed to present some of the abnormal characters above described, and death eventually results from general exhaustion.

The diagnosis of this affection has to be made in the early stages from rheumatism. This is not so easy, and, indeed, is at first impossible; but after a time, when the peculiar phosphatic condition of the urine, and the fragility or distortions of the osseous system manifest themselves, the true nature of the affection reveals itself. From rickets the diagnosis may usually be pretty readily made, by observing that, whilst rickets is a disease of childhood, osteomalacia is an affection peculiar to adult or advanced life. The occurrence of severe pains, and the greater amount of distortion, with the tendency to spon-

taneous fracture, which is observed in this disease, is never noticed in ricketty children.

With regard to treatment, but little can be done; the administration of tonics, and a general supporting plan of treatment, may arrest for a time the progress of this terrible affection; but when once it is declared, it usually progresses from bad to worse, and at last destroys the patient. Opiates may be employed to allay the pain, and in Dr. MacIntyre's case some temporary advantage appeared to result from the administration of alum; but no remedy has appeared to exercise any decided or continuous advantage in this complaint, which there is reason to believe, with Solly, is of a truly malignant character.

Tubercle of bone. — The deposit of tuberculous matter in bone plays an important part in many diseases of this tissue in children and young people of a scrofulous habit of body, being a common cause of some of the most intractable forms of chronic osteitis, circumscribed abscess, caries, and necrosis. As tubercle is almost invariably deposited in the cancellous structure, it is a frequent cause of those forms of inflammation of the articular extremities of long bones, that terminate in the destruction of the contiguous joint. In the short bones, as those of the tarsus, it commonly leads to caries and necrosis, and forming, as it often does, in the bodies of the vertebræ, it very frequently gives rise to some of the most destructive diseases of the spine, attended by the formation of large lumbar and iliac abscesses. When once tubercle has been deposited in a bone, it usually sets up a low form of inflammation in the surrounding osseous tissue, which rapidly runs into a carious condition, with the formation of curdy pus, in which masses of half-disintegrated tubercle may be seen. If this destructive action takes place with great rapidity, portions of the bone will be found to necrose in small masses, which lie at the bottom of these tuberculous and carious cavities, as may commonly be observed in some forms of strumous caries of the os calcis and head of the tibia. When the tuberculous deposit has been very extensive, and is of a more acute character, it may cause inflammation and disintegration of the whole of the articular end of a long bone, with separation of the epiphysis. These destructive changes may take place with great rapidity: I have seen them happen, in a lad whose thigh I amputated for acute tuberculous infiltration of the lower end of the femur, in less than a month from the first occurrence of the complaint, the patient, at the time of the operation, being nearly exhausted by hectic, induced by the abundant discharge from the diseased bone, and from immense abscesses in his thigh.

When, on the contrary, the tuberculous matter is deposited in small quantity in an otherwise healthy bone, it may, as it undergoes softening, dispose to the occurrence of circumscribed abscess, at the same time that chronic thickening and condensation of the surrounding bone takes place. It is in consequence of this condensation of the peripheral portion of the bone by the deposit of fresh layers of osseous tissues under and by the inflamed periosteum, and the difficulty that the tuberculous abscess necessarily experiences in traversing these hypertrophied osseous structures, that it is so apt, when deposited in the vicinity of a joint, to work its way through the cartilages into the cavity of the articulation; as on this surface no fresh deposit or condensation of osseous tissue can take place, and consequently no additional obstacle be offered to the onward progress of the tubercle, or rather of the curdy pus into which it has become transformed.

The presence of tubercle in osseous tissue thus not only gives rise to destructive changes in the bone and adjacent articulations, but will occasion inflammation and extensive suppuration in the neighboring soft parts; indeed, some of the largest chronic abscesses that form in the body, those connected with diseased dorsal or lumbar vertebræ, owe their origin, in the majority of cases, to the deposit and disintegration of tubercle in the bones. When once tubercle in bone has given rise to caries and perforation of the osseous tissue covering

it, together with plastic infiltration, and abscess and sinuses of the soft parts, these conditions will continue in a permanent manner; the fistulous tracks leading down to the bone and the cavities in it, remaining open so long as any tuberculous matter is left at the bottom of them; and in this way the patient may eventually be exhausted by the copious and continuous discharge from these osseous vomicæ. In some favorable cases, as the result of natural processes, and in others by those operations that the surgeon practises for caries, the whole of the tuberculous matter may be disintegrated, and thus eventually eliminated, a true vomica being left in the bone, or scooped out by the gouge, and then the fistulous track, whether in the soft parts or in bone, having no longer this kind of foreign body lying at its bottom, will gradually close, not by the contraction of its osseous walls, which is of course impossible, but by the deposition of a fibrous tissue by which the cavity is occluded.

Nélaton has pointed special attention to the pathology of tubercle of bone, and to the important part that it plays in the diseases of the osseous structure. He describes two forms of tubercle in this situation; the first is the encysted variety, which occurs in the form of small masses, of an opaque white or yellowish color, contained in the cyst, which is soft, vascular, and spongy, apparently of a cellular structure. This variety is stated by Nélaton to be the most common. I have certainly not found it so, but have most frequently met with the infiltrated opaque tubercle. The other form in which tubercle occurs, according to Nélaton, is an infiltration into the cancellous structure of bones. This may be in the form of semi-transparent granulations of a greyish or rosy tint, opalescent and slightly transparent; occasionally, these granulations are firm, so as almost to resemble cartilaginous deposits in the interior of the bone. The osseous structure, in the midst of which this kind of tuberculous matter is deposited, does not appear at first to undergo any material alteration. The other form of tubercle is that in which it is infiltrated as opaque puriform matter of a pale yellow color, soft, and without vascularity (figs. 212, 213). The osseous tissue, under the influence of this disease, often becomes, as Nélaton

Fig. 212.

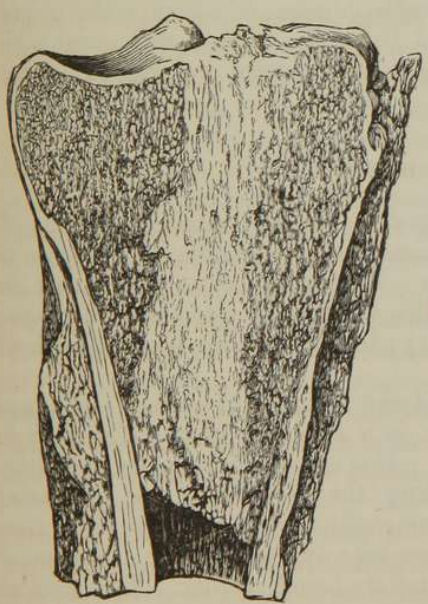
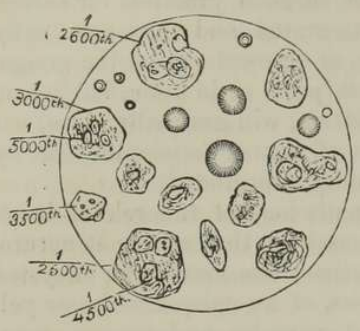


Fig. 213.

observes, more condensed than natural, the cells being obliterated so as to resemble the compact substance of bone. In some cases it may continue thus chronically thickened and indurated, but in other instances the tuberculous

inflammation will give rise to rapid and destructive inflammation of the surrounding osseous tissue, which becomes excessively vascular, and crumbles down into a carious state, with some necrosed masses intermixed. In other instances, again, as is not unfrequently observed in some of the forms of caries of the spine, or of white swelling, slow suppuration takes place in the interior of the bone, and on the sides or in the centre of the abscesses thus formed, hardened and white ivory-looking masses and knobs of osseous tissue may be seen to be deposited, these apparently consisting of the tuberculous bone that has undergone some special modification of structure.

FIG. 214



The *treatment* of tubercle of bone resolves itself into that of its effects. As its existence cannot be recognized except by the changes that it induces in the bone, the treatment must be directed exclusively to these. Thus, if it occasion circumscribed abscess, that must be opened; if caries, the diseased cavity and tissue must be scooped out, or removed in accordance with the principles already laid down; and, if disease of the neighboring articulations result, it must be managed as will hereafter be explained.

It is of importance, however, to recognize the dependence of these various affections on a tuberculous state of the bone; for, as this is always of a scrofulous character, it should necessarily occasion the constitutional measures that are employed to be specially directed to the removal of this cause. Thus, good food, sea-air, the administration of iron, of the iodides, and cod-liver oil, will form most important elements in the treatment, without which, indeed, it cannot be brought to a successful termination. The progress of these cases is generally excessively tedious. Stanley gives, indeed, two years as the time required for a strumous bone to recover itself, and in very many instances this period may even be exceeded. In this, as in all other of the chronic inflammatory affections of the bone, it is of considerable moment to continue the means of cure until the disease is fully recovered from, for relapse will occur with special readiness in the tubercular affections, if the patient be allowed to use the diseased limb or part too soon.

TUMORS OF BONE.

Exostosis. — By exostosis is meant the growth of a bony tumor from some of the osseous structures of the body. The causes that immediately give rise to this disease are usually extremely obscure. There can be no doubt that, in some instances, it is predisposed to by syphilis, scrofula, or cancerous affections; and that in other cases, again, it is hereditary; but, in general, it occurs without any distinct or appreciable exciting cause.

Exostoses are of two kinds: the one hard and compact, the other softer, and more spongy. The hard, or *ivory exostosis*, is a structure that differs both in appearance and composition from true bone. It is extremely compact and white, having a granular section closely resembling that of ivory, and presenting somewhat radiating fibres. In chemical composition, it is found to differ from healthy bone in containing more of the phosphate and less of the carbonate of lime, and also in the proportion of animal matters being smaller. This kind of exostosis principally grows from the flat bones, and as it is generally of small size, seldom produces much inconvenience, unless it be by projecting into and compressing important parts; thus, Cloquet relates the case of a tumor of this kind growing from the pubes, and perforating the bladder, and they are

occasionally found to project into the orbit, or from the inner table of the skull, upon the brain. When these bony tumors are left to themselves, they usually become stationary after a time. In some instances they have been known to necrose, and to slough away, as it were, from the parts in which they are situated. Of this termination Hilton and Boyer relate instances.

The spongy, cancellous, or cellular exostoses grow rapidly, often attain a considerable size, and are very commonly multiple. When numerous, they will often be found to be somewhat symmetrical in their arrangement. Not unfrequently they stretch across from one bone to another, bridging over joints, and thus giving rise to anchylosis; in shape, they vary greatly, sometimes being globular, at others spinous. In structure and chemical composition, they are identical with cancellated bone.

The *symptoms* of exostosis are simply those produced by a hard, thick, and slowly-growing tumor, connected with a bone, and pushing forwards the soft parts covering it. In many cases, it produces serious inconvenience by its pressure, either upon neighboring organs or mucous canals, or it may occasion ulceration of the skin lying above it.

Treatment. — If an exostosis is so situated as to occasion inconvenience or deformity, it will be necessary to remove it; and as it is a local disease, there is no fear of its returning, provided this be fully done. If, however, the whole of it be not taken away, it may grow again, and Stanley accordingly recommends that if it be so situated, as upon the cranium, that its base cannot be extirpated, potassa fusa or nitric acid should be applied to the part that is left, so as to produce exfoliation of it. The removal of these tumors is best effected by a Hey's or chain saw, or cutting pliers. In some situations, as when close upon joints, or springing from the cervical vertebræ, they cannot be interfered with; and in other cases, as occasionally happens in the neighborhood of the orbit, their density and hardness may be such, that the saw can scarcely work its way through them. There is a peculiar kind of exostosis occurring from the upper surface of the last phalanx of the great toe, pushing up the nail, and giving rise to great inconvenience. This may be removed by exposing its base and cutting it off with a pair of sharp pliers, without amputating the toe. There is a species of bony growth, called *osteoma*, consisting of a uniform elongated mass of new bone, deposited on some of the osseous surfaces, somewhat resembling a node, and differing from ordinary exostosis in not being pedunculated, that does not admit of removal, and is not amenable to any treatment.

Enchondromatous, or *osteo-cartilaginous* tumors are often met with. These have already been described when speaking of enchondroma and its pathology (p. 398), and need not, consequently, be more than adverted to here. They usually require the resection or amputation of the affected bone, according to the attachments and size of the growth; but Stanley states that in some cases, where the cartilaginous tumor of bone is of small size, it may be influenced and eventually dispersed by the local application of iodine and mercury.

Cystic tumors of bone of various kinds are commonly included under the terms *osteo-sarcoma* and *spina ventosa*, which terms having also been occasionally applied to various other solid growths, whether of a fatty, fibrous, gelatinous, or cartilaginous character, as well as to various kinds of malignant tumor springing from bones, have occasioned much confusion in the pathology of these affections. The cystic tumors of bone have been well described by Nélaton. They consist of cysts, having various kinds of fluid and solid contents. The cysts may be unilocular, and these are commonly filled with solid matter, or multilocular, and they then contain fluid. The solid masses are usually of a fibrous or fibro-cartilaginous character, filling up completely the cavity in which they are situated, and then attaining a very considerable size. They occur principally about the jaws and articular ends of long bones, especially the humerus, the femur, and the tibia. The cysts with fluid or semi-fluid contents attain a

much larger size than the last, being often met with as large as a cocoa-nut or a fœtal head. On a section being made of them, they are found to be composed of a multilocular cyst, each cavity having distinct walls, and often communicating with others. The fluid contained within these cysts is of various characters, thin and serous, sero-sanguinolent, viscid, or dark-colored, often associated with masses of fibrous tumor, appearing as if it proceeded from the central softening of these large growths. The same situations are affected by the compound as by the single cysts, but they are also met with in the shafts of long bones. From whatever part they proceed, their walls are composed of expanded bone, not uniformly thinned, but thickened and noduled at various parts, whilst it is perforated at others (fig. 215).

Fig. 215.

Cystic tumor of lower end of femur.

These cystic tumors principally occur in adults, being rarely met with in children. They constitute smooth, round, or oval growths, increasing slowly but steadily, with little or no pain, the skin covering them being of the normal color, and the veins usually blue, enlarged, and tortuous. When a certain size has been attained, so that the shell of bone is expanded into a very thin lamella, and before it is perforated, pressure on the tumor occasions a peculiar crackling or rustling noise like that produced by pressing together a broken egg-shell, or the crackling of tin-foil. Under this the elasticity or even semi-fluctuation of the tumor may be felt. This fluctuation is particularly marked after a time, when the osseous envelope has become still more expanded, or is partially or wholly absorbed.

Treatment. — When the contents are solid, there is usually no means of ridding the patient of the tumor, but by the removal of the whole growth; by excision, if it is favorably situated for such procedure, as in the jaws; by amputation, if in the limbs. When the contents of the tumor are fluid or semi-fluid, it must, if large, be treated in the same way as the solid growths are; but, if small, or if of moderate size, so as not to have materially affected the integrity of the bone, then it may suffice to remove one side of the wall of the cyst by the trephine or by excision; and then stuffing the cavity with lint, allowing it to granulate, and its walls to contract. This plan has proved especially successful in some of the cystic tumors of the lower jaw. And I have had occasion to practise it with success in a small cyst forming in the outer condyle of the humerus.

Hydatids. — Cavities are occasionally, but very rarely, found in bones, in which large numbers of hydatids are lodged; according to Stanley, both the acephalocyst and the cysticercus cellulosa have been found in this tissue, but most frequently the first. In these cases a cyst forms in the bone, which becomes thin and expanded, resembling the ordinary fluid cyst tumor, but which, on examination, is found to contain these entozoa. The treatment, as Mr. Stanley observes, must depend on the situation and extent of the disease; if it is a long bone that is affected, and that is much expanded, amputation must be had recourse to; if a flat bone, the cavity must be scooped out, and dressed from the bottom with stimulating applications, so as to get it to fill with healthy granulations.

Malignant osteoid, osteo-cancer or *osteo-cephaloma* are true malignant tumors

of bone, constituting very serious but not very rare forms of cancer. Two distinct forms of cancer of bone are included in this disease. In one form the morbid growth is *central*, springing from the medullary canal; in the other it is *peripheral*, being attached to the compact osseous substance. Encephaloid of bones is harder and more fibrous-looking than the same affection elsewhere. The cancer-cell also is not so well marked, and indeed may be absent altogether.

In the *central* cancer of bone, the tumor is found to grow in the substance of, or to spring from, the interior of the medullary canal of the bone. It is usually situated at or about the articular ends, expanding the bone, which becomes completely enveloped and incorporated in the structure of the growth, either in the form of osseous rays diverging from the centre of the tumor, or more rarely as a thin shell of bone surrounding the mass, as in the more simple growths springing from this tissue. Under either circumstance it is important to bear in mind that this form of disease is never localized, but always invades the whole of the bone; the freedom of communication between the upper and lower ends of a long bone is so great, that, as has been shown by Richet, water injected at one end exudes in a few seconds at the other. Hence the juices of a malignant structure might easily traverse the whole length of the bone, and we accordingly find on examining the osseous tissue at a distance from the tumor, that there are red patches in it here and there indicative of its infiltration with the morbid structure.

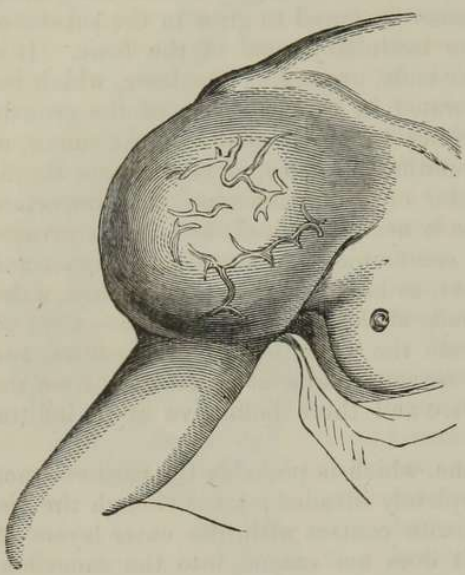
In the *peripheral* form of cancer of bone, which is probably the most common variety, the osseous tissue is not so completely invaded; for, although the disease may be situated upon, or be in intimate contact with, the outer layers of the bone, which are incorporated in it, it does not extend into the cancellous tissue, or the medullary canal. The tumor appears to spring from the periosteum, and after removal and maceration, stalactitical projections and radiating fibres may be traced into it from the outer layers of the bone. In this form of osteo-cancer, the muscles that are attached to the affected portion of bone will often be found to be extensively infiltrated with cancer-cells.

These tumors, whether central or peripheral, are chiefly of the encephaloid species of cancer, and are met with in all stages of development and of decay. Occasionally, some colloid, and more rarely melanotic matter is intermixed; but scirrhus, I believe, is never found in bone. They most frequently occur in the head of the tibia and the lower end of the femur; occasionally in the humerus and in the jaws, more especially about the antrum. It is a remarkable fact, long ago pointed out by Petit, and more recently insisted on by Richet, and which I have often had occasion to verify, that although the epiphysis may have been completely converted into encephaloid matter, the cartilage of incrustation and of the neighboring joint (fig. 217) never becomes implicated; and this, although the growth may eventually involve and include the whole of the rest of the articulation, by extension to the capsule and its soft parts. When internal organs become secondarily affected in these cases, the deposit will generally be found in the lungs.

The *symptoms* of these tumors are as follow: there is a rapidly-growing enlargement of the bone, usually with much lancinating pain, having a globular shape, feeling elastic, and sometimes semi-fluctuating. The skin covering it, at first pale, with numerous reticulated and blue tortuous veins, afterwards becomes discolored, being eventually implicated in the morbid mass. In some cases fracture of the bone takes place at the affected part (fig. 216); the neighboring tissues are speedily contaminated, the lymphatic glands become enlarged, cancerous cachexy sets in, and the patient eventually sinks. In other cases, again, the disease being central, the progress, especially in the early stages of the disease, is less rapid, though it at last develops itself with fearful violence. So long as the disease is confined within the walls of the bone, it develops itself but slowly, and does not show much disposition to affect the

constitution. I had lately a patient under my care, a man whose thigh I amputated for cancer of the head of the tibia, that had existed for four years

Fig. 216.



Osteocephaloma of the head of the humerus with spontaneous fracture of the shaft, in which I amputated successfully at the shoulder-joint.

Fig. 217.

Section of tumor — upper end and head of humerus destroyed, but cartilage of incrustation unaffected. Tumor divided by white vertical lines,—the periosteum; inside which only were the osseous spiculæ found.

without contaminating the neighboring parts, whose constitution appeared sound, and who made a good recovery. But when once the soft parts become engaged, the system is speedily contaminated. In some instances, pulsation of a thrilling kind, with or without a blowing murmur, is distinctly perceptible, especially in an advanced stage of the affection, when the vascularity of the tumor is greatly increased.

The *diagnosis of osteo-cancer* has to be made from other tumors of bone, and from aneurism. The malignant growths of bone may readily be confounded with those various forms of non-malignant disease that are commonly included under the term spina ventosa. In making the diagnosis, we may reasonably come to the conclusion that the growth is cancerous, if it occur in early life before puberty, or between this period and the early adult age; if it increase with great rapidity, and with much pain, especially of a lancinating character; if, to the touch, it present a somewhat diffused pulpiness, with much elasticity, great tension, and, at points, a semi-fluctuating feel; and, more especially, if the veins are greatly enlarged and tortuous, the neighboring lymphatic glands involved, and cachexy ultimately setting in. These conditions differing from the slow growth, the more circumscribed character and more solid feel of the non-malignant tumors, which have no tendency to the implication of neighboring structures, and which occur at later periods of life, usually enable us to make the diagnosis. There is one tumor, however, viz., enchondroma, which

occasionally in the rapidity of its growth, closely resembles the malignant diseases. Here the diagnosis is confessedly extremely difficult, though the more solid character, the less degree of elasticity, and the absence of lymphatic enlargement, or implication of contiguous tissues, will often enable us to establish the true nature of a tumor before its removal.

The diagnosis from aneurism is necessarily unattended by any difficulty so long as the sac is pervious to fluid blood, and presents the characters that are met with in this condition. But if the sac have become consolidated by the deposit of stratified lamina, and thus have assumed the characters of a solid tumor, it may readily enough be mistaken for a tumor springing from the osseous structures, and amputation has occasionally been performed on this supposition. In these cases, however, the history of the progress of the disease will do more to elucidate its true nature than anything else, attention being more especially paid to the early symptoms of the tumor, when the aneurism was still filled with blood.

Treatment. — No means are of any avail in cases of osteo-cancer except the removal of the part diseased by amputation or excision. These operations are however not very promising, as there are few forms of cancer in which the disease returns more rapidly in a secondary manner, than that of the bones. The rapidity of recurrence will, however, greatly depend upon the form of the disease, the time at which amputation is performed, and on the part where it is practised. It should always if possible be had recourse to in the earliest stage of the disease, before glandular or constitutional infection has set in. If the glands are enlarged, and cachexy has already occurred, little can be expected in the way of ultimate cure, but yet I have known cases in which, even under these unfavorable circumstances, the patient has made a good recovery; his life having been prolonged for months. I believe that return is much more speedy and certain after amputation in the peripheral than in the central form of osteo-cancer, provided in the latter the whole of the bone has been removed, owing to the more extensive contaminations of the soft parts in the former than in the latter case. The selection of the line at which amputation should be performed is of great importance, and the result will materially depend upon the judgment displayed in this. If the limb be removed in the continuity of the diseased bone there must necessarily be a great probability of the very rapid return of the morbid action in the stump, and this probability amounts to a certainty in those cases in which the disease is central, and in which the whole of the medullary canal and cancellous structure are implicated, and infiltrated with cancer. In cases of peripheral osteo-cancer, this return in the same bone may not take place; indeed, I have seen one case of the kind in which the disease affected the lower end of the tibia, and that bone was amputated in its upper third; in this case, after a lapse of some months, fatal recurrence of the disease took place in the pelvic bones, but not in the stump. As, however, the peripheral is more rare than the central form of the disease, and as there are no means of ascertaining the precise kind before removal, the rule, I think, should be definite to amputate at or above the next joint; at the hip-joint, in cancer of the femur; in the thigh, for that of the bones of the leg; and at the shoulder, when the upper arm is affected.

Where the lower part of the femur, however, is involved, amputation through the trochanters may sometimes be substituted for disarticulation at the hip joint, the latter operation being so formidable and so fatal that the surgeon may think it advisable not to subject the patient to so serious a risk; or the amputation might be performed through the trochanters, and then the head of the bone extirpated from the acetabulum. In this way the severity of the operation and the extent of incised surface would be lessened, whilst the whole of the diseased bone would be removed

In the peripheral form of osteo-cancer, however, the muscles inserted into the

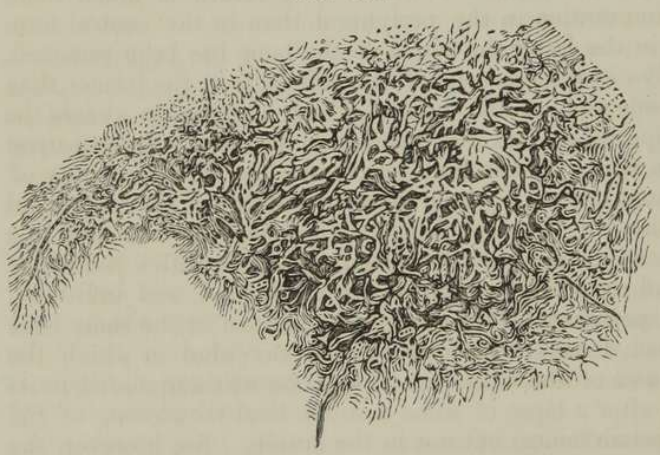
affected bone often become speedily contaminated by the disease, and this contamination may spread widely through the substance of any particular muscle. Hence I think the rule in these cases should be to amputate not only above the diseased bone, but, if practicable, above the origins of the muscles in the neighborhood of the disease; thus if there be a malignant tumor of the bones of the forearm, amputation should be done above the humeral attachments of the muscles of the forearm.

The propriety of excision of some bones, as of those of the face, in this disease, must depend on whether the morbid deposit is limited to the structures that can be excised. This operation can rarely be advantageously practised in malignant tumors, there being in general too great an implication of the soft structures in the neighborhood to make such a proceeding justifiable.

Sanguineous tumors are occasionally met with in bones; according to Stanley they are of two kinds. 1st. Those in which the tumor is composed of a vascular substance, having the general characters of erectile tissue, and bearing on section a close resemblance to certain nevi (fig. 218). This tumor may be removed without the liability to reproduction. The 2d form of sanguineous tumor consists of a cyst formed in the cancellous structure of a bone, and containing either fluid or coagulated blood. According to Stanley, this tumor expands the osseous walls, and will gradually cause ulceration of the skin and profuse hemorrhage. The treatment consists in the amputation of the limb, or the excision of the affected bone, as was successfully done by Travers, who removed a clavicle that was the seat of this disease.

Pulsating tumors of bone, or *osteo-aneurisms*, though of unfrequent occurrence, are of considerable importance to the practical surgeon, on account of the difficulty that often exists in establishing a diagnosis between them and aneurisms. It is only of late years that this kind of disease has been fully recognized, and it is principally to the labors of Handyside, Nélaton, Stanley, and Roux, that we owe an acquaintance with its characters.

FIG. 218.



Aneurism by anastomosis of one of the parietal bones.

Tumors springing from bone, whether of a cartilaginous, fibrous, or cystic character, may have pulsation communicated to them from a neighboring artery; but the true pulsating tumors of bone owe their pulsations to some inherent peculiarity of structure, which appears to consist either in the development of a vascular tissue of abnormal character, or else in the simple enlargement and dilatation of the vessels of the bone. In the first, and most frequent class of cases, those in which new tissue is developed in the osseous structure, we usually find them partake of an encephaloid character; a creamy, curdy, or brain-like, soft and very vascular mass is formed as an essential and principal constituent of the tumor. This might consequently with propriety be termed an *encephalo-osteo-aneurisma*. This abnormal mass will be found to present every shade of transition from true encephaloid cancer to a purely vascular tissue of an erectile character. In the second, and more rare form of the disease, a structure is developed in the bone which originally, and, in many cases

throughout, is a vascular, erectile growth, closely resembling capillary nevus in its structure, composed of an infinity of blood-vessels, interlacing in every possible way, so as to form a soft, reddish-yellow tumor. In other cases, again, a hollow cavity is formed in the bone, scooped out of the cancellous structure and filled with blood, which is partly liquid and partly coagulated, and into which arterial branches freely open. The shell of bone surrounding this cavity is very thin and expanded, being usually absorbed at one point, where it often becomes at last perforated. This is the form of disease that constitutes the true aneurism of bone.

These various kinds of pulsatory tumor of bone have been met with in almost all parts of the body; most commonly the cancellous articular ends of the long bones, more particularly of the tibia, the radius, the humerus, and the femur, have been found affected. The pelvic bones are also not unfrequently the seat of these growths, and they have been encountered in the cranium, the ribs, and indeed in connection with most of the osseous structures.

In its early symptoms an osteo-aneurism closely resembles the ordinary forms of spina ventosa, being oval in shape, uniform, and elastic to the touch, growing slowly, without enlargement of the veins or discoloration of the skin, characters that it possesses in common with most other tumors of bone. The special signs by which it is individualized, however, are its pulsation and bruit: the pulsation is very distinct, superficial, and commonly of a thrilling character; in other cases it is directly impulsive, and distinctly expansive; the bruit is most usually soft and blowing, but not unfrequently harsh, loud, and whizzing. In some cases the bruit is absent, though the pulsation continues distinct; this, according to Nélaton, is most frequently the case in true osteo-aneurisma. In the pulsating encephaloid form of the disease, I have heard the bruit peculiarly loud, rough, and superficial. On compressing the main artery leading to the part of the limb in which the tumor is situated, all movement and bruit commonly cease in it, and it lessens in size. By pressing upon the tumor when it is thus diminished, it will commonly be found to have a bony margin, with a central depression, more especially in those cases in which there is no encephaloid entering into its composition, the growth being apparently composed of erectile and expanded osseous tissue, filled with fluid blood. In some cases, however, the tumor is fed by several arterial branches, which may be felt distinctly pulsating under the skin. This is more particularly the case when it occurs upon the bones of the pelvis and the scapula, and then the bruit and pulsation cannot be made to cease in it. All these signs are commonly somewhat intermittent, appearing perhaps in the earlier stages of the disease, and disappearing as it advances; or the reverse may occur, the pulsation and bruit becoming distinct as the disease increases in size and meets with more resistance in its outward growth.

Diagnosis. — It is of considerable importance in many cases to diagnose the different forms of pulsating tumor of bone from one another, some being of a truly cancerous character, whilst others appear to consist of simple expansion of the vascular element of the bone, with atrophy of its osseous substance, and consequently the prognosis also in the two conditions is very different. The true osteo-aneurism has so many signs in common with the pulsating encephaloid tumor of bone, that in many cases it is almost impossible to effect the diagnosis; yet it is well to bear in mind that the malignant form of the disease is not unfrequently multiple, occurring, with pulsation and bruit, in more situations than one; thus I have seen growths of this kind, with their signs well marked, springing both from the pelvis and ribs. The true osteo-aneurism is only met with in the articular ends of long bones, whereas the malignant disease, though commonly occurring in these situations, is also frequently found seated in other parts of the body. Besides these, there are two conditions which, in many cases, will enable the surgeon to determine that the pulsating

tumor is an osseous aneurism; viz., the absence of all bruit, though the pulsation be distinct, and the detection by firm pressure, and after the tumor has been diminished by the compression of the artery leading to it, of an osseous margin around its depressed centre.

From ordinary aneurisms, the diagnosis of these affections is, in many cases, attended by almost insuperable difficulties. So great are these, that there are many cases on record in which the most experienced surgeons of the day have ligatured arteries for tumors that were supposed to be aneurismal, but which have turned out to be pulsating growths connected with bone. The principal points to be attended to in effecting the diagnosis, are the situation of the tumor, which may occur away from the ordinary sites of aneurism, in parts of the body where there is no vessel large enough to give rise to such a disease, as for instance, about the head of the fibula or the side of the pelvis. Then, again, its incorporation with the subjacent bone, the want of a distinctly limited and circumscribed outline, and the existence in many cases of plates of bone in the wall of the tumor, giving rise, perhaps, on pressure, to the peculiar rustling or crackling sound characteristic of bony growths, will enable the surgeon to come to a conclusion as to the true nature of the tumor. In this he will be further assisted by its giving on compression a soft, doughy, or spongy feel, or appearing as a depression surrounded by an osseous margin. In many cases also the less impulsive character of the beat of the tumor, the peculiar shrill and tremulous whizz in the pulsation and bruit, will throw much light on the nature of the disease. But yet it cannot be doubted, that when tumors of this kind occur in some of the ordinary situations of aneurism, as about the brim of the pelvis, and in the popliteal space, that the diagnosis is surrounded with difficulties that no amount of surgical skill or tact may be able to overcome. From ordinary tumors of bone, the existence of pulsation and bruit will always suffice to distinguish the growths under consideration.

Treatment.—Incision into a pulsating tumor of bone, or any attempt to remove it without its osseous connections, is clearly contrary to the rules of good surgery; and when it has been practised, the hemorrhage has been of the most alarming and dangerous character. Resection has been had recourse to in some instances, as when the disease has been seated on the cranial bones, but without success. Liston, in a tumor of this kind growing from the scapula, which he called "an ossified aneurismal tumor of the sub-scapular artery," excised the greater portion of the bone from which it sprang; but fungous growths reappeared in the wound, by which the patient was at last exhausted. When the disease has proceeded to such an extent as to produce extensive alteration in, and destruction of the tissue of the bone affected, amputation of the limb is the only resource left to the surgeon. This operation is also called for in those cases in which the disease returns after other means, such as the ligature of the artery, have been practised. In these cases, if the disease partake at all of the encephaloid character, the limb must be removed at a point above the affected bone.

The result of the ligature of the main artery leading to the tumor depends greatly upon the nature of the growth. When it is partly composed of encephaloid or other solid tissue, but little good can result from this proceeding, the tumor continuing to increase by an inherent growth, that will continue as long as the vitality of the limb is maintained; and we accordingly find that in all such cases in which this operation has been practised, the progress of the tumor has either not been retarded, or if the pulsations have been stopped, and its size lessened for a time, the activity of the symptoms has speedily returned, and amputation been rendered necessary. When, however, the tumor has partaken more of the characters of true osteo-aneurism, then a more favorable result has followed the ligature of the main artery of the limb. In a case of this kind seated in the radius, in which Roux ligatured the brachial artery,

a complete cure resulted. The same also occurred to Lallemand; and in a patient of Dupuytren's, there was no return of the disease for six years, when it recurred, and amputation became necessary. These results are sufficiently satisfactory to justify the surgeon in having recourse to the ligature, or perhaps the compression of the main artery of the limb, in those cases in which the tumor could be ascertained not to partake of the nature of encephaloid.

CHAPTER XLIII.

DISEASES OF JOINTS.

The various joints of the body may become the seat of inflammatory affections of an acute or chronic character, of strumous disease, or of various other morbid conditions, such as more or less permanent rigidity, or anchylosis, the formation of foreign bodies within their cavities, or their malignant degeneration. In studying these various articular affections, it must be borne in mind that a joint is composed of a number of different tissues, of synovial membrane, cartilage, ligament, bone, and capsule, or investing fibrous expansion. In any of these structures the disease may primarily begin, though eventually the morbid action often spreads to other tissues besides that which was originally involved. The merit of having been the first to point out the true mode of studying these affections in reference to the different structures in which they have originated, and to have set aside that coarse pathology which, under the general terms of "arthritis" and of "white swelling," confounded together these various diseases, is certainly due to the labors of Sir B. Brodie.

SYNOVITIS.

Inflammation of the synovial membrane, the most common perhaps of all the articular affections, may be acute, subacute, or chronic in its characters. Whatever form it assumes, synovitis usually results from exposure to cold, especially in rheumatic or syphilitic constitutions. In these cases it commonly happens that more joints than one are implicated at the same time; and the affected articulations are most frequently those that are most exposed by the thinnest covering of soft parts, and by being especially subjected to transitions of temperature, such as the knees and ankles. Injuries of joints, as blows, bruises, wounds, or sprains, will also frequently occasion this inflammation; but when arising from this cause, it is seldom of an unmixed kind, being usually associated with inflammation of the other textures that enter into the composition of the articulation.

As uncomplicated acute synovitis is never a fatal affection, it is seldom that we have an opportunity of studying its pathology. It would, however, appear from the result of the examination of joints in cases of synovitis from injury, as well as from the result of experiments of Richet, Bonnet, and others, who have induced traumatic synovitis in animals, that there is in the first instance an inflammatory congestion and vascularity of the membrane, attended by loss of its peculiar satiny polish. The synovia is then increased in quantity, as well as altered in quality, becoming thin and serous, and after a time intermixed with plastic matters that are poured out with it. If the disease progress favorably, these products are more or less completely absorbed. If, however, as is more

rarely the case, the inflammation goes on to an unfavorable termination, the vascularity and swelling of the synovial membrane increase, until at last it becomes so turgid and distended with blood and effused fluids, that a kind of chemosis of it results; a thin, purulent-looking fluid, composed of granular corpuscles floating in a serous liquid, is poured out, and disintegration, with thinning and erosion of the cartilage, and probably complete destruction of the joint, ensues. In other cases, granulations are thrown out on the looser portions of the membrane, which, becoming injected with blood-vessels, constitute fringed and villous membranous expansions, lying upon the subjacent, disintegrated, and eroded cartilage.

The termination of synovitis will depend mainly on its cause. When of a simple uncomplicated character, arising, as the result, perhaps, of rheumatic influences, it will in most cases terminate in complete resolution. In other instances, however, plastic matter may be thrown out, that either assumes the form of warty vegetation or concretions within the joint, or of bands stretching across its interior, or incorporated with its capsule, occasioning more or less permanent stiffness. When synovitis arises from wound it usually goes on to suppuration within the joint, superficial erosion or disintegration of the cartilage, and eventually, if the limb be not removed, to complete disorganization of the interior of the articulation, and to more or less complete anchylosis. The same happens in the puerperal inflammations of joints, and in those that arise from pyemia, in which cases the morbid action commencing on the synovial membrane extends downwards to the cartilages, eventually leading to destructive disorganization of them.

The *symptoms* of synovitis consist of pain and heat of the joint, with distension and fluctuation of it. If it be large and exposed, the pain is severe, especially at night, being greatly increased by moving or pressing upon the articulation; it is usually sharp, but when the disease occurs in rheumatic or gouty constitutions, of a gnawing character. In purulent synovitis occurring from pyemia, it is usually very superficial, indeed almost cutaneous. On laying the hand on the joint it will be felt to be hot.

The swelling of the affected joint is considerable, and evidently depends on the accumulation of fluid within the synovial sac, the extreme outline of which is rendered apparent by the tension to which it is subjected. Thus in the knee it rises up high in the thigh under the tendon of the quadriceps extensor, in the elbow under that of the triceps. There is but little if any effusion into the surrounding tissues, and hence the outline of the joint can be distinctly felt, and undulation perceived in it. The limb is usually semiflexed, as giving the patient most ease, and the joint cannot be moved. The constitutional febrile disturbance is tolerably severe, especially if the affection occur in a rheumatic constitution.

The disease, at first acute, may terminate in a subacute or chronic form; or subacute at its commencement, it may fall into a chronic condition. Chronic synovitis is characterized by all the symptoms of the acute variety of the disease, but in a less severe degree. The swelling and weakness of the joint are the most conspicuous local conditions. In some cases, the swelling from accumulated serous fluid is so considerable as to constitute a true dropsy of the joint, *hydrarthrosis*. This accumulation of fluid, partaking in various degrees of the characters of serum and synovia, is usually preceded or accompanied by evidence of synovial inflammation; but, though this generally happens, it is not invariably the case. Richet, in particular, has recorded instances from which it would appear that inflammation is not a necessary, or invariable accompaniment of the affection, the synovial membrane being indeed preternaturally white, and looking as if it had been washed or soddened; and though these cases are rare, those that commonly present themselves to the surgeon being of a decidedly inflam-

matory character, yet their occasional occurrence is sufficient to establish the existence of a passive, as well as an inflammatory form of the disease.

The presence of an abnormal quantity of fluid in the joint is always readily perceived by its fluctuation and undulation, by the deformity that it produces, and by the peculiar shape that it communicates to the part. Thus in the knee, which is the most common seat of this affection, the patella will be felt to float, as it were, on the subjacent liquid; and the capsule of the joint projects distinctly in three situations, viz., on either side of the ligamentum patellæ, and above that bone. In the elbow, there is a soft and fluctuating swelling on either side of the olecranon, and under the tendon of the triceps; and in the shoulder there is a general soundness and distension of the articulation. It is said, that in some cases, the distension of the joint has been so great, that the synovial membrane has been ruptured, and the fluid poured forth into the surrounding cellular tissue. In these cases, it is probable, however, that some destructive change in the synovial membrane preceded its rupture.

The chronic subacute synovitis and hydrarthrosis usually terminate favorably, but, occasionally, more particularly in strumous constitutions, the disease runs on to suppurative destruction of the joint. This, however, is rare, but yet its occurrence, in some instances, should make the surgeon careful not to confound the fluctuation of the serous accumulation with that of the purulent collection. In the latter instances there will always have been the precursory symptoms of inflammation.

The *treatment* of synovitis depends partly on the severity of the symptoms, and partly on the cause of the disease. If the inflammation be acute and arise from injury, it requires to be actively treated by venesection, if the patient is young and strong; but in all instances by the free and repeated application of leeches to the inflamed articulation, followed by fomentations and accompanied by perfect rest of the part on a splint, or on pillows properly arranged. In some instances the cold irrigation will be found to be of essential service; at the same time saline purgatives with antimony must be given, and the patient kept on a low diet.

If the disease is of a rheumatic character, leeches must be applied, followed by hot fomentations, and rest of the part in the elevated position; at the same time, colchicum, with salines, if there be much febrile disturbance, and if there be much pain at night, in combination with Dover's powder, should be administered. In some instances, where colchicum disagrees, great benefit will result from the administration of Dover's powder and calomel, in small but frequent doses. When the disease is of syphilitic origin, leeches are not often required; but the application of blisters, followed by calomel and opium, will be attended with marked success.

When the synovitis is of a subacute or chronic character, the same principles of treatment must be adopted, modified according to the intensity of the affection. In these forms of the disease, rest is perhaps the most important element in its treatment, everything else proving nugatory unless this be attended to; the limb is usually best fixed by leather splints, buckled on so that they may be removed in order to make the necessary applications to it. In these cases repeated blisterings over the whole of the joint constitute perhaps the most useful local means that we possess; in a more advanced stage, counter-irritation by means of stimulating embrocations, together with douches, either of warm sea-water or of some of the sulphurous springs, such as those of Harrowgate, Aix, or Barèges, will prove most useful; and when all inflammatory action has been subduced, and weakness of the joint merely is left, this should be properly strapped with soap-plaster, spread upon leather. Among the internal remedies likely to be of most service, may be mentioned the iodide of potass, either alone, or in some bitter infusion.

In hydrarthrosis, rest and repeated blistering will usually promote the removal

of the fluid. In addition to this, the employment of pressure and friction, with absorbent remedies, as the iodine or mercurial ointment, conjoined with the internal administration of the iodide of potass, or a mild mercurial course, will often procure the absorption of the fluid. If these means fail, we have a very powerful means of cure at our command in the subjection of the joint with tincture of iodine. This plan, a sufficiently bold one, has been much employed in Paris by Jobert and Velpeau, and in Lyons, by Bonnet. These surgeons use the tincture diluted with two or three parts of water. A small trochar is introduced into the joint, a moderate quantity of the serous fluid is let out, but not all, and then a corresponding quantity of the iodine solution is thrown in; and after being left for a few minutes, allowed to escape. Inflammation of the joint, which is a necessary result of this procedure, comes on. This is then treated by ordinary antiphlogistic means, and, according to the statements of the French surgeons, has in no case been followed by any serious consequences, but in several instances by a complete cure without anchylosis; a new and healthy action having been imprinted on the synovial membrane. The mode of treatment does not appear as yet to have met with much support in this country, yet it certainly deserves a trial, though it should not lightly be had recourse to, as it is evident that the induced inflammation might exceed the expected limits. After dropsy of the joint has been removed, the articulation is usually left weak for some length of time, in consequence of the stretching to which its ligaments have been subjected; here cold douches and an elastic bandage will constitute the best modes of treatment.

ARTHRITIS.

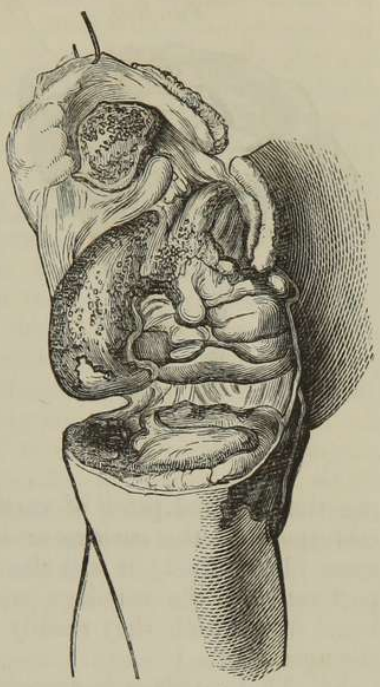
By arthritis, is meant inflammatory disease of an acute or chronic kind, of the whole or greater part of the structures that enter into the formation of a joint. This affection may commence in the synovial membranes, and then spread to the other articular tissues, or it may begin in the cartilages or bones, and in some rare instances it may perhaps take its origin in the fibrous capsule surrounding the articulation; whether it can ever commence in the ligaments is a question that is not as yet satisfactorily determined.

In arthritis, the principal changes are undoubtedly found to take place in the cartilages, at the same time it must not be supposed that all morbid appearances that are found in these structures are the result of inflammation, as erosion and absorption of their tissue may take place, independently of any diseased action. The long-continued disuse of a joint, as in the treatment of fractures, may occasion this; and in old people it is very common to meet with a porcellanous or ivory-like deposit on the articular ends of the bones, which, however, does not prevent the joints being used, though it may occasion stiffness and pain in them. According to Quekett this porcellanous deposit is of two kinds, one consisting of unorganized earthy matter; the other, of true bone, having the Haversian canals filled with phosphate of lime.

In *acute* arthritis the cartilages are usually found ulcerated and eroded in patches of varying size, exposing bone, which is rough and vascular. The remains of the cartilage are softened, inelastic, opaque, and thickened, and separate easily from the subjacent bone, which can be felt rough and grating. The synovial membrane is usually thickened and very vascular; the vascularity being most distinct about those parts, where the erosions and grooves in the cartilage are deepest, and often assuming a dentated or fringed appearance. In other parts, especially about the circumference of the joint, masses of plastic matter are deposited underneath, and upon the synovial membrane; these are smooth and semi-transparent, having a somewhat fatty look; the ligaments are relaxed, vascular, and softened, and the interior of the joint filled with thin, flaky, and light-colored pus. The capsule and the cellular tissues

around are thickened, and either infiltrated with pus, or clogged with the same kind of plastic matter that is seen in the interior of the joint. The articular end of the bone is enlarged, soft, and vascular; and in strumous cases may be the seat of tuberculous infiltration (fig. 219.)

Fig. 219.



The changes that take place in the cartilages in this disease have excited much attention amongst surgeons, and a good deal of difference of opinion exists as to the mode in which they are induced. Many surgeons hold the doctrine that cartilage being extra-vascular, the changes that take place in it are accomplished through the medium of the contiguous synovial membrane or bone, and consequently are secondary to disease of these tissues. We may, I think, conclude that this disease of cartilage may arise in three ways: 1st. Through the medium of the synovial membrane; 2d. Through the medium of the subjacent bone; and 3d. By means of changes taking place in the cartilage itself.

1st. The destruction of cartilage, as the result of synovial disease, may best be studied in cases of wound of a joint. In these cases it will be found, if the joint be examined before complete disorganization of it has occurred, that the diseased action spreads from the synovial membrane, where it is most intense, downwards into the substance of the cartilage, which, superficially diseased, becomes more healthy the deeper the examination of it is carried. Immediately under the swollen, gelatinous-looking, brightly-injected synovial membrane, the cartilage will be found to be reddened, roughened, and softened. On examining a thin slice of this, it will be found to be composed of granular matter and nuclei of cells whose walls have disappeared. At a little greater depth than this it will present an opaque matrix, with cells, some perfect, others imperfect or disintegrating, and below this level we shall come to healthy white cartilage, with clear matrix and well-formed cells.

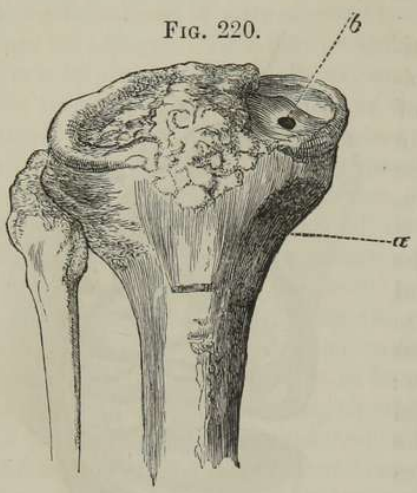
The disorganization of the cartilage will eventually go on to its complete removal, and to the exposure of bare and roughened bone. It is in this way that destruction of joints as the result of punctured wounds, pyemia, or puerperal inflammation, results.

Aston Key advocated the doctrine that a peculiar disease was set up in the synovial membrane by which a fimbriated or fringed vascular network or tissue was formed, by means of which the cartilage was absorbed; and that as this membrane extended, so did the removal of the cartilage go on. That an appearance of this kind in inflamed joints is of common occurrence is doubtless the case, but Goodsir has shown that Key erred in attributing the disintegration of the cartilage to this membrane; for he states that a fibrous tissue forms in a diseased joint as the result of the disintegration of the cartilage, and that this, which is connected either with the synovial or osseous surfaces, speedily becomes vascular. So far, therefore, from being the organ by which the cartilage is removed, it is the result of prior disease in this structure. At the same time it cannot, I think, be doubted that a villous injected state of the synovial membrane will modify the nutrition of the subjacent cartilage in such a way, that disintegration, erosion, and apparent ulceration of it will ensue.

2d. Disease of cartilage primarily dependent on morbid action in the sub-

jacent bone is, I believe, one of the most frequent modes of the disorganization of joints in strumous subjects, and most certainly leads to those rapidly destructive affections of joints, in which amputation or excision is required. In these cases, either as the result of violence, or from constitutional causes, the articular ends of a bone, or the whole of a bone if it be one of the tarsal, becomes congested, inflamed, carious, or necrosed, sometimes infiltrated with tubercle. (Fig. 220, *a*.) In consequence of this disorganization of the osseous tissues, the incrusting cartilage becomes detached, its under or attached surface softened, and at last perforation takes place. (Fig. 220, *b*.) This process of disintegration and at last perforation and erosion of the cartilage, takes place in a direction from below upwards. So soon as perforation occurs, the whole of the interior of the joint becomes acutely inflamed and suppuration is set up in it, the ligaments loosen, and complete disorganization ensues (fig. 220). On examining the diseased patch of cartilage in such cases as these, it will be found to correspond to the carious or tuberculous bone, from which it is separated by some bloody fluid; it will also be seen that the under edges of the erosion or perforation in the cartilage are separated to some extent from the subjacent bone, from which they readily peel off, and that they are bevelled off towards the aperture.

Fig. 220.



3d. That cartilage is susceptible of primary change of the nature of inflammation or ulceration, induced by the action of its own vessels, is the opinion of Brodie, Mayo, and Liston, all of whom have observed true vascularization of cartilage. This condition, however, is extremely rare, and is certainly not one of the more common forms of joint-disease, seldom occurring except in the more chronic stages of arthritis.

These, however, are not the sole changes that take place in cartilage in arthritis; the observations of Goodsir, of Rainey, and of Redfern, all point to the fact that cartilage, like other extravascular tissues, is subject to other transformations, independent of the prolongation of vessels into it. The changes that ensue are, according to Redfern, of the following kind:—The cartilage-cells enlarge, become rounded, and granular-looking, and instead of containing two or three nuclei, a considerable number are enclosed in the cell-wall; eventually these corpuscles break up and are disintegrated. The matrix of the cartilage now softens, and according to Redfern, splits up into fibres or bands which become nucleated. A species of fatty degeneration also, as pointed out by Rainey, takes place, and helps to soften and break down the structure of the cartilage. In the more advanced stages of disease of cartilage, we find masses of porcellanous deposit attached to the ends of the bones in plates and layers, taking the place of the eroded cartilage.

In other cases, again, a soft, pulpy, and vascular fibro-plastic deposit of a greyish, ashy, or reddish-brown color, with whitish streaks of a firmer material running through it in various directions, takes the place of the cartilage that has been removed, or that has undergone fibro-cellular degeneration. On examination under the microscope, this will be found to be composed of plastic material, with cartilage-corpuscles intermixed, and with the subjacent bone in a state of disintegration and softening. This condition of joints I believe to be analogous to the "pulpy degeneration of the synovial membrane" of Brodie. It would appear, from the microscopical examinations that I have made of this

material, in various cases after the removal of joints, to which my attention was first directed by Dr. Quain, as occurring in a patient of his, whose elbow-joint I excised, that it is either fibro-cellular degeneration of the cartilage, or an imperfect attempt at repair set up in the articulation, after the removal of the cartilage by previous disintegration and disease. On making a vertical section of the surface of the diseased articulation in the case alluded to, it was found that the pulpy and villous substance covered the bone to the thickness of a line and more in some parts. The bone was found to have its cells filled with oil-globules, but surrounded by tolerably healthy osseous tissue, showing the usual laminæ and bone-corpuscles. Nearer the diseased surface the laminæ and corpuscles became less distinct, and, still nearer, the cells of the bony tissue appeared to be surrounded merely by a layer of fibrous texture, in which irregular particles of bone were observed. These particles, which were elongated, irregular in form, and rounded off at the angles, were very aptly compared, by Dr. Quain, to crystals in a state of solution. At the diseased surface, the place of the cartilage and synovial membrane was occupied by a fibrous texture abounding in cells, larger than pus-cells, nucleated and spherical, containing numerous granular particles. Irregular masses of cartilage, undergoing the same process of softening as the bony particles already mentioned, appeared in this fibrous texture. The morbid appearances found in this case were so characteristic that they may be taken as the type of this peculiar morbid condition, which I have since repeatedly met with in other articulations besides the elbow, more particularly those of the fingers and the knee, and which always, I believe, constitutes an incurable form of disease. I have only met with this condition in instances in which the articular affection has been of very old standing, and fallen into a truly chronic state.

When repair takes place in a joint, the cartilages of which have been eroded or destroyed, it is by the articular ends of the bones becoming connected, and the surface from which the cartilage has been removed filled up by fibro-cellular tissue, forming a kind of cicatricial material that leaves the joint permanently stiffened. In other cases again, porcellanous deposit takes the place of the eroded cartilage, and, in some instances, the exposed osseous surfaces may grow, or become soldered together, forming a permanent anchylosed and immovable state of the articulation. Under no circumstances does cartilage, when once destroyed, become regenerated.

Causes.—In some instances, acute necrosis of the shaft of one of the long bones, as of the tibia, will run on to destructive action in the terminal articulations, the cartilages becoming undermined, softened, and perforated. It not unfrequently happens that the arthritic disease is the result of a morbid condition of the articular ends of the long bones, or of those short bones that enter into the formation of the joint; this we especially see in diseases of the foot, of the elbow, of the knee, and hip; but it is a condition that, I believe, may occur in any joint. The bones usually become, in the first instance, the seat of tuberculous infiltration; this runs into unhealthy suppuration, which gives rise to caries and limited necrosis (fig. 213, *a*); as the diseased action approaches the articular surface, the incrusting cartilage becomes loosened, detaches, and at the same time gradually disintegrates, and becomes perforated (fig. 213, *b*), nutrition in it being arrested or modified by the morbid state of the subjacent bone. When once the cartilage becomes affected, the whole of the interior of the joint speedily suppurates, and is destroyed. In other cases, inflammatory congestion, but without the formation of tuberculous matter, takes place in the articular ends, which become somewhat expanded, and then, without any suppuration occurring in the osseous structure, the cartilage gradually separates or peels off, and becomes softened and necrosed. This condition is often met with in disease of the tarsal articulations.

Diseased action is very seldom primarily set up in the ligaments of the joint,

though these structures commonly become elongated, softened, and destroyed, as a consequence of other forms of articular disease. But though primary inflammation of the ligaments is so rare an affection as to have been denied by many, yet it certainly does occasionally occur. This is especially seen in the hip-joint, where the inflammatory affection may commence in the ligamentum teres; illustrative of which there is a very beautiful model in the University College Museum.

Inflammation may commence in the fibrous capsule of the joint: this we find more particularly to be the case when the affection is of a rheumatic character; in these cases inflammation, running into suppuration and slough of this structure, will commonly spread to the internal parts. In some instances, this form of disease gives rise to the deposit of masses and layers of bone in the cellular structures outside the articulation.

Arthritis commonly results from wounds of joints, or injuries, such as sprains and fractures occurring in their vicinity, more particularly in young people, and in those of a lymphatic constitution. It also occurs as a not unfrequent accompaniment of pyemia (p. 381), and of some of the morbid conditions of the puerperal state. The puerperal inflammation of joints is of a very destructive character, most generally speedily terminating in suppurative disorganization. One or several joints may be affected, and the knee is the one that I have seen most frequently and seriously involved. Puerperal arthritis probably depends upon a purulent infection of the blood as the result of uterine phlebitis. Arthritis not unfrequently occurs as a consequence of scarlatina, and I have especially seen the knee-joint affected in a destructive manner after this disease. In some forms of albuminuria there is also a great tendency to inflammation of the joints, and indeed I have so frequently seen that form of renal dropsy which follows scarlet fever accompanied by serious inflammation of some joint, as almost to look upon one condition as the sequence of the other.

The *symptoms* of arthritis that are most marked are the pain, heat, swelling, and peculiar position of the joint. The pain is often severe, tensive, and throbbing; so acute is it sometimes that the patient screams with agony, he cannot bear the bed to be touched, the room to be shaken, or the slightest movement communicated to the limb: any attempt at examination of the joint in such cases being attended with insupportable agony. There are usually nocturnal exacerbations, and the pain is commonly referred with especial severity to one particular spot in the joint; thus it is generally felt at the inner or under side of the knee-joint, and at the outer aspect of the hip. The heat of the diseased joint is considerable, and is often accompanied with more or less superficial redness. The swelling is uniform, involving the whole of the articulation, and not projecting at certain parts of it, as when the synovial membrane alone is affected; it is generally not very considerable, and has a soft and doughy, rather than a fluctuating, feel. As the disease advances, however, the swelling generally increases suddenly, and to a considerable extent, either in consequence of the irritation of the synovial membrane, or of the accumulation of pus within or around the joint. In many cases the synovial membrane gives way, and the pus from the interior of the joint becomes widely diffused through the muscular interspaces of the limb, forming enormous abscesses and long sinuous tracts. The position of the affected limb is peculiar, and that attitude is insensibly adopted in which the patient will have the greatest amount of ease; thus the knee is semi-flexed and turned outwards, the thigh is adducted, and the elbow is bent. Spasms or startings of the limb, often of a very sharp and painful character, come on at times, more particularly at night.

The constitutional disturbance is very severe, and of an actively febrile type. As the disease progresses, suppuration takes place within the joint, which becomes hot and red, with a good deal of throbbing pain, and at last fluctuation is perceived where the coverings are thinned. In some cases the suppuration

occurs with very great rapidity, and luxation of the head of the bone takes place. In other cases an abscess forms external to the articulation, and extensive purulent collections become diffused through the limb. As the joint becomes loosened by the destruction of its ligaments, the bones become mobile, and grate against one another where the incrusting cartilage has been removed, thus giving rise to very severe suffering. The cartilages may however in some cases be very extensively destroyed, and yet no grating take place; this is owing either to the destructive action being limited to the edge of the incrusting cartilage, the opposing surfaces being sound, or else to the interior of the articulation being filled up with plastic matter after the removal of the cartilages. But though abscess, either within the joint or external to it, usually forms when the bones grate and the cartilage disintegrates, yet it occasionally happens that these conditions may take place — those symptoms that are indicative of the erosion of the cartilage, such as painful startings of the limb, grating, and preternatural mobility of the joint, — and yet no abscess forms; all the symptoms subsiding under proper treatment, and the joint recovering, though perhaps with a certain degree of anchylosis. If suppuration take place, the constitutional disturbance usually partakes of the irritative type, the patient suffering severe pain, and being worn out by want of rest. Hectic may occur and death from exhaustion and irritation, unless the diseased part be removed; in other cases it falls into a state of chronic thickening, with perhaps fistulous openings leading down to the diseased structures, and in some of the more favorable instances the patient may recover, with a permanently rigid joint.

Abscess may form external to, but close upon, the capsule of a joint, and closely simulate disease of the articulation. In these cases the absence of serious constitutional disturbance, the irregularity of the swelling, greater on one side than the other, the absence of all rigidity about the joint, and of other severe local symptoms, such as pain, starting, looseness, or grating, will enable the surgeon to effect a correct diagnosis.

In the *treatment* of acute arthritis, perfect rest of the articulation is of the first moment. Unless this is secured no after-treatment can be of any avail. The limb should be comfortably supported on pillows, or laid upon a well-made and softly-padded leather-splint; at the same time blood should be freely taken away by cupping or leeching the affected part, and this local depletion must be followed by assiduous fomentations. In the acute stage of the disease the internal remedy from which the most essential service may be derived is the calomel and opium pill (gr. ij. and gr. $\frac{1}{2}$) every fourth or sixth hour, at the same time that a strict antiphlogistic regimen is persevered in. After the violence of the symptoms has been subdued, the joint may be repeatedly blistered; but in many instances most benefit will be derived by the application of the actual cautery. This agent, when properly applied, yields much more certain and successful results than any other form of counter-irritation with which I am acquainted. The patient having been anæsthetized, a cauterizing iron heated to a black-red heat should be rapidly drawn over the diseased articulation in a series of parallel lines, across which an equal number of cross bars are again drawn so as to char but not destroy the true skin. A good deal of inflammatory action is thus set up, followed by slight suppuration. When this has subsided, the application of the hot iron may, if necessary, be repeated; in this way the deep gnawing pain will usually be readily removed, and suppuration of the joint may be averted. For counter-irritants to be of any use, they must be employed before suppuration has set in; I believe that it is only torturing the patient unnecessarily to have recourse to these agents when once pus has formed in the articulation. In order that full benefit should be derived from this plan of treatment it must be persevered in steadily for a considerable length of time, and should be conjoined with a moderately antiphlogistic and alterative treatment. With this view, the bichloride of mercury in doses of from $\frac{1}{8}$ to $\frac{1}{12}$ of a grain may be advantageously

given with the compound decoction of sarsaparilla, or, if there be much debility, with the compound tincture of bark, nourishment, and even stimulants being conjoined with it, in proportion to the advance of the debility. When suppuration has taken place in this joint, more particularly if the skin covering it be reddened at any one part, the abscess should be freely opened.

In some cases, even when abscess has formed, the joint being perfectly loose and grating, by perseverance in the above plan of treatment, both local and constitutional, a good and useful limb may be left; and although there be mobility and grating, provided there be no sign of abscess, the surgeon should never despair of obtaining a satisfactory result.

The practice of making free incisions into a suppurating joint, as advocated by Mr. Gay, is a great improvement on the former method of merely puncturing it. If a small aperture only is made, air gets admixed with the pus, which becomes offensive and irritating, and being unable to escape freely, sinks to the bottom of the articulation with débris of the disintegrated cartilages, &c., giving rise not only to much local mischief, but to proportionate constitutional disturbance. By freely laying the joint open, all this is prevented; exit is given to the pus through one or two incisions that extend the whole length of the articulation; no constitutional disturbance can occur from pent-up and putrid matter, and the joint has a better chance of healthily granulating.

After the formation of abscess the prognosis is more unfavorable, when large joints such as the knee or hip are affected; or, when those are implicated which are important to life, such as the articulations of the vertebræ; so likewise, when the articular ends of the long bones are affected it is seldom that the joint can recover itself, as we have caries or necrosis complicating its disease and keeping it up. When the articulation is very sinuous as in the carpus, or when a number of small joints communicate with one another, if not directly by synovial membrane, at all events indirectly through the medium of ligament and of fibrous tissue, as in the tarsus, a cure can scarcely be anticipated. In all these cases, hectic and great constitutional irritation usually come on; or the joint becoming useless or cumbersome, its removal must be practised either by excision or amputation.

The result will at last in a great measure depend upon the state of the bones that enter into the conformation of the joint. If these be sound, or not primarily affected, and the patient's constitution has got over the effect of the occurrence of suppuration in the joint, anchylosis more or less complete may be confidently looked for. But if the articular ends of the bones be primarily or deeply implicated, then excision or amputation will be the only alleviation.

When an inflamed joint appears to be disposed to undergo a cure, its repair by anchylosis must be facilitated by keeping it in a proper position, such as will be most useful to the patient in after-life; the straight one for the knee and hip, and the semiflexed for the elbow. At the same time it may be useful to strap the joint firmly in the proper position in the way recommended by the late Mr. Scott, when it is the knee that is affected, or when the hip or elbow are implicated, fixing it well by means of starch bandages. Scott's plan of treatment consists in spreading on pieces of lint, the strong mercurial ointment, to every ounce of which ʒj of camphor has been added; strips of soap-plaster spread upon leather are then cut of a proper length and breadth, and the joint firmly and accurately strapped up, the limb having previously been bandaged as high as the joint that is strapped. This dressing may be left on for a week or two until it loosens or gives rise to irritation; over the whole a starch bandage may be applied. In many cases, I have found it advantageous to strap up the joint with a plaster composed of equal parts of the emplast. ammoniaci cum hydrargyro and the emplast. saponis or belladonnæ. These applications not only fix the joint and promote the absorption of the plastic

matter that is deposited around it, but by acting as gentle counter-irritants remove the remains of the inflammation that may be going on within it.

STRUMOUS DISEASE OF JOINTS.

By "white-swelling" is meant a very chronic form of arthritis occurring in scrofulous subjects. These diseases present peculiar characters; the affected joint is enlarged and rounded, the bony prominences being effaced by a uniform, doughy, semi-elastic, or pulpy swelling, occupying the interstices of the articulation. The integuments covering it preserve their white color, and there is usually but little pain felt except in moving the limb, and the position is always that in which the patient has most ease, the joint being generally semiflexed. There is a degree of stiffness and rigidity in the joint, and in consequence of the wasting of the limb from disuse, the affected articulation appears more swollen than it really is.

This condition has not in many cases any definite starting-point, but appears slowly to supervene upon some slight injury, as a twist, or blow, or strain; at other times it commences with a subacute synovitis, assuming its peculiar characters by occurring in a strumous constitution, and is especially liable to happen in children and females. The general health does not appear at first to suffer much, but as the disease advances symptoms of irritation and hectic declare themselves. This affection is always characterized by a special tendency to run on to suppuration. This tendency may be checked by proper treatment, but in the great majority of cases it at last passes into this condition. The joint suffers from exacerbations of intercurrent attacks of inflammation, the limb swells and becomes œdematous, and abscess finally forms in and around the joint; often around, before it takes place within. When this is opened, the constitutional symptoms become more severe, hectic speedily sets in, and strumous deposit takes place in other organs, such as the lungs, which at last carries off the patient.

In this affection the tissues immediately external to the joint, as the fibrous capsule and the investing cellular membrane, are always much thickened and infiltrated with fatty and plastic matter; this gelatinous infiltration having a great tendency to run into unhealthy suppuration greatly adds to the mischief that ensues. In the interior of the joint we find much the same kind of changes that have been described as characterizing acute arthritis; the cartilages have lost their polish, their elasticity, and their firm hard section, being softened, eroded, and disintegrated; the synovial membrane is removed in parts, and is here and there vascularized; in others it is replaced together with the cartilages, either by large quantities of the semi-transparent gelatinous-looking fatty deposit, or by the pulpy grey or brownish fibro-cellular material that is met with in arthritis. The ligaments are inflamed, softened, and destroyed, being converted into somewhat similar materials; and the interior of the joint is filled with a purulent-looking synovial fluid, thin and yellow, usually containing a large quantity of fatty matter. The bones undergo important changes in this disease, the articular ends becoming expanded and enlarged; and though this was denied by Crowther, Russell, and others, it is affirmed by more modern surgeons, and I have had repeated opportunities of determining the fact. In all the cases that I have examined the osseous tissue has undergone important changes, the compact structure becomes thin and expanded, and the cells of the cancellated, filled with a bloody and fatty serous fluid. It is softened, often cutting readily with the knife, and owing to the deposit of fat presents a more homogeneous section than healthy bone. In many cases, tuberculous matter is deposited in it. From this it would appear that the principal changes that take place in a joint affected with white swelling consist in a

kind of fatty degeneration of the tissues that enter into the formation of the articulation, associated with an unhealthy strumous inflammation of the parts, and the consequent deposition of considerable quantities of semi-transparent and lowly-organized plastic matter which, in its turn, has a tendency to undergo the same structural change, or to run into unhealthy suppuration.

In the *treatment* of white swelling, we must bear in mind that we have to manage a truly scrofulous inflammation and its effects. Our first object should be to prevent, if possible, the occurrence of suppuration. In the early stage, when the affection has come on insidiously, without any very active symptoms, we must trust to general anti-strumous treatment, to the influence of diet, of sea-air, and the administration of alteratives, cod-liver oil, and iodine. In the local treatment, rest, with perfect immobility of the articulation, is the most important element, without which all the rest is futile. The limb should be put into such a position as is not only most easy to the patient, but that would leave the most useful member in the event of a stiff joint resulting. If the symptoms are of rather an acutely inflammatory kind, leeches may be applied; these, however, must be used as sparingly as possible, being confined either to the earlier stages of the disease, or to the subdual of any more active intercurrent inflammation. Rest is best secured by leather or gutta-percha splints in the earlier stages, and at a later period, by the application of the starch bandage to the limb. This kind of application will be found to give the most efficient support, and will keep the whole of the limb perfectly motionless, so that the patient can take open air exercise, and walk with the aid of crutches, without the risk of injuring the diseased joint. In this respect, the starch bandage presents great advantages over the short leather splints generally used. It may readily be cut open opposite the diseased joint, so as to admit of the application of proper dressings to it. The actual cautery is extremely beneficial in these cases applied as directed (p. 615), or caustic issues may be put in, at a little distance from the articulation, so that there may be no risk of the inflammatory action penetrating to it.

After all inflammation has, in this way, been removed, and nothing but thickening and stiffness of the joint are left, measures must be adopted for removing these conditions, and restoring the flexibility of the articulation by frictions with somewhat stimulating and counter-irritant embrocations, and eventually its strength, by douches of sea-water. The swelling and puffiness that are left, together with the debility dependent on relaxation of the ligaments, are perhaps best remedied by the use of Scott's strapping; but pressure should not be applied so long as there is evidence of active inflammation going on in the articulation, which it would certainly increase.

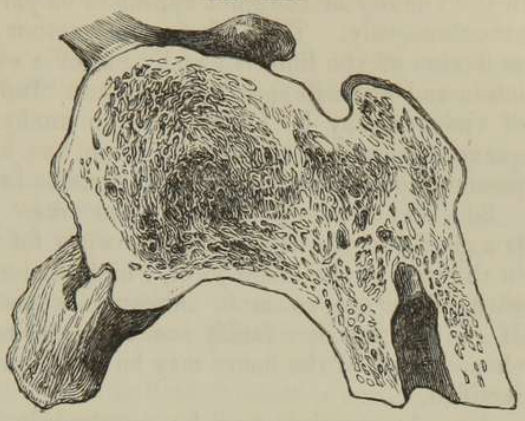
If abscess forms, this must be freely opened by an incision of a proper length, the joint poulticed, and the patient's general health attended to, so as to promote the evolution of granulations, and the prevention of hectic. In these cases, if the limb can be preserved, its after-utility, and the patient's comfort, will mainly depend upon the position in which it is allowed to anchylose

ANCHYLOSIS, OR STIFF JOINT.

Anchylosis is invariably the result of the destruction of a joint by chronic inflammation, being the only mode in which nature can effect its repair, and consists in the more or less complete consolidation of the parts around and within the articulation. It is of two kinds: the *incomplete*, or *fibro-cellular*, and the *complete*, or *osseous*. In the *incomplete*, or *fibro-cellular* anchylosis, the stiffness of the joint may be dependent on thickening and induration of its fibrous capsule, or on the formation of fibroid bands as the result of inflammation within the joint, or in consequence of the cartilages and synovial mem-

brane being in part or wholly removed, and their place supplied by a fibroid or fibro-cellular tissue, by which the articular ends are tied together. It may also be materially increased by the tonic contraction of the muscles around the joint. The *complete* or *osseous* anchylosis is of two kinds: in one, all the soft parts within the joint are destroyed, and the osseous surfaces have coalesced, or are fused together by direct bony union. This is most commonly seen in the hip, knee, and elbow (fig. 221). In the other, there has been fibro-cellular deposit, or degeneration within the joint, and the bones, united partly by this, are also tied together by arches or bridges of osseous matter, thrown out external to the articulation, and stretching across from one side to the other It has been supposed that these masses proceed from the ossification of the ligaments, or even the muscles; but, from the inequality of their appearance, it is evident that they are new and accidental formations. In the incomplete anchylosis there is always some degree of mobility, however slight, and, indeed, perhaps only perceptible on deep and close examination. In the complete form of stiff joint, the articulation is perfectly rigid and immovable. It not unfrequently happens, in old standing cases of diseased joint, that more or less complete anchylosis is taking place at one part of the articulation, whilst caries or necrosis of the bones is going on at others. Under such circumstances, excision or amputation will, probably, be the course to be pursued.

Fig. 221.



The *treatment* of anchylosis is, in the first instance, of a precautionary nature, — that is to say, that when the surgeon finds that the establishment of anchylosis is, as it were, the natural means of cure adopted by nature in a deeply-diseased joint, his efforts should be directed to seeing that the joint becomes anchylosed in such a position as will leave the most useful limb to the patient:— thus, if it be the hip or knee, that the anchylosed joint be in the straight position; whilst if it be the elbow, that it be placed at a right angle.

When once the anchylosis has occurred, the treatment to be adopted will depend partly on the degree of stiffness, whether it be fibrous or osseous, and partly on the object to be attained, whether this be merely the restoration of mobility in a part anchylosed in a good position, or the remedying of the deformity occasioned by faulty anchylosis.

1st. In attempting to restore the mobility of a joint anchylosed in a good position, as of a straight but stiff knee, the surgeon may usually succeed if the anchylosis be only of a fibrous character, (when some degree of movement will always be perceptible in the part,) by the employment of passive motion, frictions, and douches, more particularly with warm salt water or the mineral sulphureous springs. In the more obstinate cases, and where the immobility appears to depend, in some degree, at least, on fibrous bands stretching across the limb, an attempt might be made to divide these subcutaneously. In doing this no mischief can result, for the synovial structure of the joint having been destroyed, no dangerous amount of inflammation can be set up in it.

2d. When fibrous anchylosis has taken place in a faulty position, — if, for instance, the knee be bent, or the elbow straight, the first thing to be done is to place the limb in such a position that it will be useful to the patient. This may most readily be done by chloroforming the patient, and then forcibly

flexing or extending the limb, as the case may require, when with loud snaps and cracks it will usually come into proper position. Should any of the tendons in the vicinity of the joint appear to be particularly tense, they may be divided subcutaneously. The inflammatory action that follows this forcible extension or flexion of the limb is usually but of a very trivial character; an evaporating lotion and rest will speedily subdue it. Indeed, it is surprising what an amount of violence may be inflicted on an anchylosed joint without any bad consequences ensuing. After the limb has been restored to its proper position, passive motion and frictions may tend to increase its mobility.

3d. When osseous anchylosis has taken place, and the position of the limb is a good one, it will generally be wiser for the surgeon not to interfere; except in the case of the elbow-joint, which, under these circumstances, may be excised with advantage, so as to substitute a movable for an immovable articulation. If the position be a faulty one, the osseous union may be divided, or a wedge-shaped piece of the bones may be taken out, and the position of the limb thus rectified.

4th. Amputation may be required in cases of faulty anchylosis with so much atrophy of the limb as to render this useless, or in cases in which there is necrosed or carious bone co-existing with anchylosis and rigid atrophy of the muscles of the limb.

CHAPTER XLIV.

ON EXCISION OF JOINTS AND BONES.

To the surgeons of this country is undoubtedly due the merit of originating and carrying out the practice of excising diseased joints and bones with the view of saving a limb, by the removal of those morbid structures that would otherwise have necessitated amputation. Although the older surgeons, dreading amputation, on account of the difficulty they experienced in arresting the hemorrhage from a stump, had recourse to various gouging, scooping, and scraping operations in cases of diseased bone, yet they never attempted the excision of a joint, or indeed the resection of a whole bone. The articulated ends of bones were first excised in a compound dislocation of the elbow as far back as 1758, by Wainman of Shripton, and afterwards by White, Bent, and Orred in cases of compound dislocation of the humerus. In 1762, Filkin of Northwich excised the knee for disease, and in 1775, Justamond cut out the olecranon and two inches of the ulna for diseased elbow-joint. The first distinct publication on the subject was by Mr. Park, in 1782, the object of which was to show that in some of those affections of the knee and elbow for which amputation had hitherto been considered indispensable, surgery possessed another resource "in the *total extirpation of the articulation*, or the entire removal of all the bones which form the joints, with as much as possible of the capsular ligament." In the same year, Moreau excised the ankle-joint, and some years subsequently, the head of the humerus and the knee-joint. The new practice made few converts, however, and in 1805, Mr. Park, in another publication expresses his mortification that it had not met with the success in this country that it deserved, and that if it had not been for the Moreaus in France it would have fallen into complete oblivion. Although these operations continued to be occasionally performed, it was not until a quarter of a century later that they were again prominently brought before the profession, and the

second revival was due to the Edinburgh surgeons, chiefly to Liston and to Syme. Since then, they have continued to gain in favor, and now constitute that department of surgery which has been termed the *conservative*, or more correctly the *preservative*.

Before proceeding to discuss the different resections in detail, we must endeavor to lay down some general rules for their performance in those cases in which they are alone admissible.

The excision of an articulation may be practised for the following reasons: —

1st. As a substitute for amputation in cases in which the joint is so extensively diseased, that the patient will be worn out by the discharge or pain, unless it is removed. Here a useful limb may be secured by the sacrifice of the diseased part.

2d. In some cases of articular disease in which amputation would not be justifiable, excision may be done in order to hasten the cure, and thus to save years of suffering to the patient.

3d. Excision may be done in cases in which amputation is not practicable: as in disease of the hip-joint or temporo-maxillary articulation.

4th. As a substitute for other and less efficient treatment, in order to restore the utility of a limb or joint; as in osseous anchylosis of the elbow, or faulty anchylosis of the knee.

5th. Excision may be required in bad compound dislocations and fractures into joints, especially in gunshot injuries; as of the head of the humerus and elbow.

As a general rule, such resections are more required for diseases of the articular ends of bones than for simple disorganization of a joint. If only the soft structures of a joint are involved, it usually happens that without the necessity of resection a useful limb will result — if in the upper extremity with fair mobility of the articulation — if in the lower, with more or less complete anchylosis, not perfect mobility perhaps, but yet sufficient for a fair basis of support. But when the constitution is very strumous, or the bones very extensively affected, we can scarcely look for recovery of the limb to such an extent as to become useful to the patient.

For resection to succeed, the following conditions appear to me to be necessary: —

1st. That the disease be not too extensive, so that its removal would entail such an amount of mutilation of the limb, as to render it less useful to the patient than an artificial member would be. This is especially important in the lower extremity. If the bones are so extensively affected as to require to be shortened by a considerable extent — for several inches — a limb would be left, that instead of serving as a proper basis of support to the patient, would only be an incumbrance. In the upper extremity, length and strength are of less consequence than in the lower; the preservation of the hand is the chief thing to aim at, and if this be effected, the bones may be encroached on to a greater extent than is proper in the lower limb.

2d. The disease for which resection is practised should be allowed to become chronic before any operation is undertaken: for this there are two reasons. First, because in the acute stage of disorganization of a joint, it is not always possible to say, however unpromising the case may appear, whether anchylosis may not result, so that as useful a limb would be left as could be obtained by resection. And, secondly, if the joint be excised whilst acute and active disease is going on, inflammation and diffuse suppuration of the medullary canal is apt to set in—a condition very apt to be followed by phlebitis and pyemia. In the only fatal instances of resection of the elbow-joint that I have witnessed, death resulted from this cause, the operation having been performed whilst the articular affection was acute.

3d. The soft parts about the joint must be in a sufficiently healthy state

There are two morbid conditions connected with the soft parts that may interfere with the success of resection. First, they may be so thinned and permeated by sinuses, and so adherent to the bones, that an insufficient covering would be left. Or, secondly, the long-continued existence of strumous disease in joints and bones may give rise to a great deposit of lowly-organized plastic matter around the articulation. This material becomes insusceptible of healthy organization, and slowly suppurates. Sinuses form in it, the integuments covering it become blue and doughy, and the soft parts around the seat of operation fall into a state of strumous disorganization that prevents alike the formation of a false joint, of osseous anchylosis, or of the healing of the wound, and thus leads inevitably to the ultimate amputation of the limb.

4th. The state of the patient's constitution must necessarily influence the surgeon materially in his determination whether to resect or to amputate. If the constitution be tolerably sound, or if the general health has given way, provided that it has done so as the simple consequence of pain, irritation, and continued discharge, resection will have a fair prospect of success. But if the patient be very highly strumous, or decidedly phthisical, there will be little prospect of his being able to bear up through the long convalescence that follows resection. A slight degree of pulmonary disease, however, that appears to be rather the result of the long-continued irritation of the local affection than of any constitutional taint, need not be a bar to these operations. In such cases, I have several times had occasion to observe that the general health improved rapidly after the removal of the local disease.

5th. The extremes of life are unfavorable to resections. In very early childhood, these operations are seldom necessary, the natural processes usually sufficing, with very little assistance, in eliminating diseased bone, and the disorganized joints admitting readily enough of anchylosis. If the disease is too severe for this, it will usually be found to be associated with so strumous a constitution as to interfere with healthy reparative action of any kind. At advanced periods of life, destructive joint disease is not very common, and when it does happen, it is generally not in constitutions fitted to stand up against the prolonged drain consequent on these operations. It is at the early adult age that the diseases most frequently occur that render resections necessary, and at which these operations are best borne.

When a bone, as the os calcis, has been entirely removed, it is never of course regenerated, but its place is occupied by a firm fibrous cicatrix.

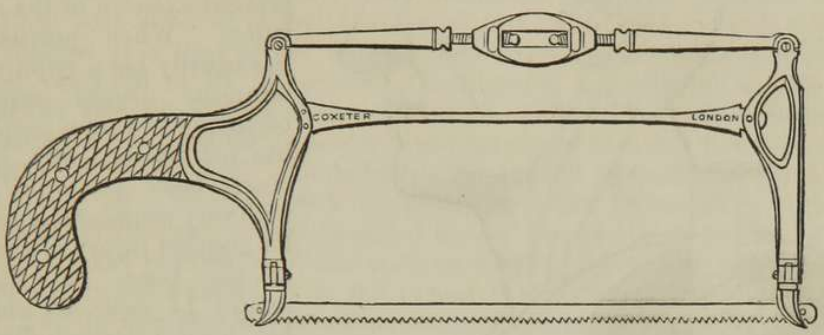
When partial excision of a bone is practised, the result varies according to the tissue that is removed. If a portion of the compact tissue is cut away, callus is thrown out. If it is the cancellous structure that is scooped out, the cavity left is filled up by a dense fibrous mass, which may eventually ossify.

When a joint has been excised, either osseous or ligamentous anchylosis may take place, and the surgeon should endeavor to secure osseous union in some, fibrous in other cases. Thus, when the knee has been excised, as a sound and firm limb is desirable, osseous anchylosis should if possible be brought about; whilst in the upper extremity, where mobility is of more use than strength, ligamentous union is most desirable. In these cases, the ends of the bones become rounded, and are united by a dense mass of fibrous tissue which envelopes them, and to which the insertions of those muscles that are naturally connected with the articular ends that have been removed, become attached.

The instruments required for resection are of a somewhat varied character; strong scalpels and bistouries, straight and sharp-pointed. In addition to these, I have found a strong-backed, probe-pointed bistoury, with a limited cutting edge, of great utility in clearing the bones. The pliers should be of various sizes and shapes (figs. 205 to 208), and gouges will be found useful for scooping out suspicious patches on the cut osseous surfaces. For ordinary purposes, a small amputating saw will, I think, be found the most convenient instrument for

dividing the bones, but in some cases a narrow keyhole saw, or that introduced by Mr. Butcher (fig. 222), will answer best. The last instrument is especially

Fig. 222.



useful when it is intended to cut the bone obliquely, or when the space is limited; for, as the blade is narrow and its angle can be changed at pleasure, any required direction can be communicated to the cut. The chain-saw is perhaps not used so frequently as it might be.

With regard to the steps of the operation, they must of course vary with the different resections, but there are some general rules that may be laid down as applicable to all cases.

1st. The incisions through the soft parts should be sufficiently free to expose thoroughly the bones to be removed. By making them, as far as practicable, parallel to tendons, blood-vessels, and nerves, parts of importance may readily be avoided.

2d. As little of the bone as possible should be removed. It is seldom that the shaft need be encroached upon, and care should always be taken to avoid opening the medullary canal. It is of importance, also, not to mistake roughened deposits of new for caries or necrosis of the old bone.

3d. The gouge may be applied to any carious or tuberculous cavities, or patches, that appear upon the surface of the freshly-cut bone, and, in this way, shortening of the bone by the saw may be materially avoided.

4th. Skin, however redundant, should seldom if ever be cut away. The flaps, at first too large, soon shrink down to a proper size, and if trimmed are very apt to become too scanty.

5th. After the operation, light dressings only should be used. As healing always takes place by granulation, no accurate closing of the wound is necessary, but it is sufficient to lay the limb on a pillow, or well padded splint, and to apply water-dressing. When it begins to granulate, more accurate attention to position is required.

6th. The constitutional after-treatment should be of a nourishing or stimulating character. As there will be a great drain on the system, and a prolonged confinement to bed, the strength must be kept up under it by good diet. These operations are always of a serious character, in many cases fully as much, or even more so, than the amputation of a corresponding part, owing to the large wound that is often inflicted, in the more extensive division of the bones, — to the necessity of making the incisions in the midst of diseased or injured structures — and to the more prolonged character of the after-treatment. Hence it is of especial importance that the general health should be carefully maintained after these operations.

Excision of the shoulder-joint is not so commonly required as that of many other articulations; disease of this joint not being of very frequent occurrence, and, when it happens, often terminating in false anchylosis, without suppuration taking place. When abscess and necrosed bone are met with about the

houlder, it will frequently be found that the coracoid or acromion processes are at fault rather than the joint itself, and extraction of sequestra formed there may prevent excision of the articulation. When practised, it has usually been required for strumous disease, especially occurring in young people. It has not unfrequently, of late years, been performed, and with very considerable success, for gunshot injury of the head of this bone. M. Baudens relates 14 cases in which it has been practised for these injuries during the Crimean campaign, and of which only 1 proved fatal. The articulation may most readily be exposed by making a semi-lunar flap about three inches in length, commencing at the posterior part of the acromion, cutting across the line of insertion of the deltoid, and carried up to the inner side of the coracoid process. Or the surgeon may adopt ⊤ ⅂ or ⊓ shaped incisions. I think, however, that the elliptical, or ∪ shaped is preferable, or less muscular fibre is sacrificed by it. By a few touches of the scalpel a large flap composed of the deltoid muscle may thus be raised, and the diseased articulation fully exposed. As the capsule and the ligaments are destroyed by the morbid action that has taken place in them, the head of the bone may readily be turned out of the glenoid cavity; and being freed by a few touches of the knife, and isolated by passing a spatula behind it, may be removed with a narrow saw (fig. 224). In doing this, the shaft of the humerus should be encroached upon as little as possible, not only that the bone may not be shortened more than is necessary, but in order that wound of the circumflex arteries may be prevented, which will certainly happen if the incision be carried too low down. After the removal of the head of the bone, the glenoid cavity must be examined; if this be carious, it may be removed most conveniently by means of gouge-forceps and the gouge, care being taken that all diseased bone is thoroughly scooped away. After the operation, the flap must be laid down, and retained in position by two points of suture, and the arm well supported in a sling, the elbow especially being raised. The wound unites by granulation, and though the deltoid muscle does not recover its full utility, a very excellent limb and most useful fore-arm and hand are left to the patient, as may be seen by the accompanying drawing (fig. 224), taken from a lad whose shoulder-joint I removed some years ago. I last saw this boy about four years after the operation had been performed, and then found that the upper end of the humerus had been drawn up underneath and between the acromion and coracoid processes, where a false joint had formed. The arm was extremely useful, and the parts below the elbow well

Fig. 223.

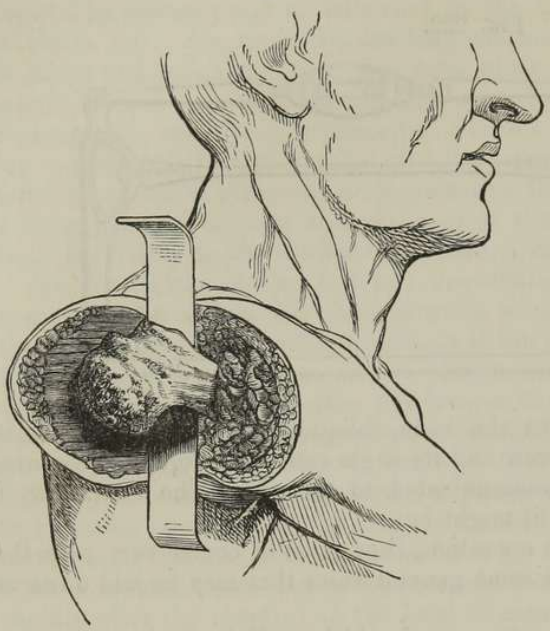


Fig. 224.

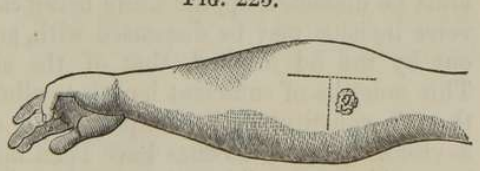
developed. The upper arm was two and a half inches shorter than the other. The excision of this joint is not devoid of danger. Velpeau records 13 cases of death following it, and states that many more have occurred.

The scapula has occasionally been excised in part, or in whole, for gunshot injury or disease. Most commonly these operations have been practised after the arm had been removed at the shoulder-joint, the state of the scapula requiring its ablation at a later period, an operation that I saw admirably performed about ten years ago by Mr. Fergusson. Occasionally, however, the scapula has been excised without previous amputatien of the arm. Thus Liston removed three-fourths of the bone for a vascular tumor springing from it. South excised the whole of the body of the scapula by sawing through its neck, and Syme has recently taken away the bone with its processes entire. Operations such as these are rarely required, and when called for can scarcely be performed in accordance with any positive rule, the operator varying the extent and arrangement of his incisions according to the extent of the disease, the situation of sinuses, &c. In whatever way practised, there is one rule, however, that should be attended to, viz., that the axillary border of the bone should be the last to be interfered with, on account of the hemorrhage that may be expected from this situation.

The *Clavicle* has been partially or wholly excised by Travers, Mott, and others. In caries or necrosis of this bone, portions of it may be gouged away or extracted without much difficulty; but when in consequence of the growth of tumors, the removal of the whole or greater part of the bone is required, the operation is one of the most hazardous in surgery, as a glance at the anatomy of the parts lying beneath the bone, and encroached upon by the morbid growth, will indicate. In Mott's case 40 ligatures were applied. The sternal end of the clavicle has been excised by Mr. Davie of Bungay in a case in which dislocation backwards had resulted from deformity of the spine, and the luxated end gradually pressing upon the œsophagus, threatened the life of the patient. The bone was cut through by means of a Hey's saw about an inch from its sternal end, and the sterno-clavicular ligaments having been divided, the portion of bone was forcibly elevated, and at last extracted.

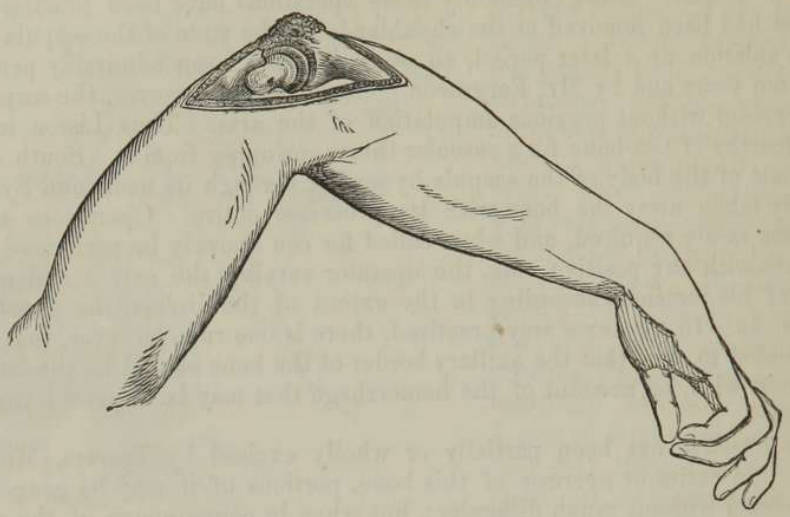
Excision of the elbow-joint has been more frequently practised than that of any other of the articulations, and the result has upon the whole been far more satisfactory. This operation may be required, 1st, for a chronic disease of the joint; 2d, for osseous anchylosis; and 3d, for injury. In those cases in which it requires to be excised for disease, it will generally be found that after disease has existed for a considerable time in the joints, the limb will be useless, and the soft parts around it swollen, spongy, and perforated by fistulous openings. In other cases there will, however, be very little external evidence of mischief, merely one or two fistulous apertures leading down to the condyles and to the olecranon, the joint being permanently lexed and swollen, and the arm so useless that it cannot support the weight of the hand. On exposing the articulation, perhaps caries, with complete destruction, and with or without necrosis of the articular ends, the loose pieces of dead bone lying in the cavity of the olecranon, or in one of the condyles, may be found. Most commonly the radius is the last bone that is affected, the ulna and opposite side of the humerus being generally first diseased. If osseous anchylosis have occurred, whether in the straight or bent position, excision of a portion of the consolidated bone may also advantageously be practised, as in these cases a useful and movable articulation may be substituted for one that is rigid and fixed. In cases of compound frac-

Fig. 225.



ture or dislocation of the elbow-joint, more or less complete resection of the protruding, and possibly splintered fragments, may be required.

Fig. 226.



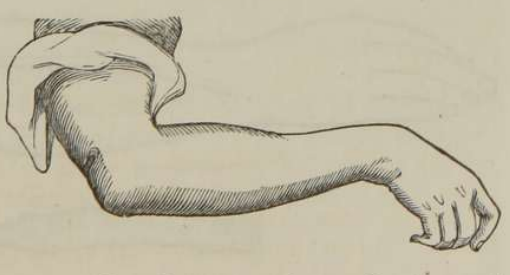
Excision of the elbow-joint is a very successful operation. I have only lost one patient out of ten cases in which I have done this operation. The principal danger after excision of the elbow-joint probably arises from diffuse suppuration of the humerus. I have seen this happen in two fatal cases; and in a third, in which the patient lost his life, it is probable that death, which was attributed to pneumonia, remotely occurred from the same cause. The elbow-joint may be excised in three ways: 1st. By an ⊢ shaped incision (fig. 225); 2d. By the H incision; and 3d, By a single longitudinal incision (fig. 226). Of the two first, I prefer the ⊢ shaped, as it leaves a better result, with less cicatrix, than the H incision.

The patient having been laid prone, the perpendicular cut should be made parallel to, and a line or two to the outer side of the ulnar nerve; being commenced at least two inches above the olecranon, and carried down to about the same distance below it. The transverse incision should then be made directly across the olecranon, to the outer side of the joint, and extended as far as the extremity of the outer condyle (fig. 225). The two triangular flaps thus made must be dissected up, the knife being carried close to the bones. Or the transverse incision may be dispensed with, and the bones readily exposed and turned out by the 3d method, that of the single perpendicular incision (fig. 226). This must be of sufficient length to allow of the sides being held well apart, and then it constitutes the simplest plan of excising the elbow that can well be devised. After the bones have been fairly exposed, they must be cleared to the inner side of the joint; in carrying the incisions in this direction, the edge of the knife should always be kept against the bones, and their sinuosities closely followed, so that the ulnar nerve being dissected out from behind the inner condyle, may escape injury. If the incisions are properly planned, and the knife kept in contact with the bone, the nerve ought not to be exposed during the operation, more particularly as it is usually imbedded in a quantity of plastic tissue. When the posterior part of the joint has been laid bare in this way, the knife should be carried round the tip of the olecranon, and this process then removed with cutting pliers. By forcibly bending the joint, pushing the forearm upwards, and lightly touching the ligaments with the point of the knife, the interior of the articulation will be fully exposed. If the whole of it is diseased, the surgeon must, of course, excise it completely; if it is only partially

affected, it is better also to practise complete excision than to limit the removal to those portions only that are implicated. By means of a small narrow saw, the articular end of the humerus is separated from the rest of the bone; the upper end of the ulna and head of the radius may either be removed in the same way, or by means of cutting pliers. There is never any necessity to place a spatula before the bones, as the parts of importance anterior to the joint could not easily be wounded, being completely protected by the brachialis anticus. The ulnar nerve will occasionally, however, be in some danger, and it must be guarded or drawn on one side by a bent copper spatula. In this operation it is of great consequence, so far as the after-utility of the arm is concerned, not to remove more of the bones than is absolutely necessary; the shaft of the humerus, for instance, should never be encroached upon, but it will be quite sufficient to limit the excision to the articular surface; should any carious portions of the bone extend beyond this, I think it is better to scoop them out with the gouge than to remove them in any other way. The excision of the ulna and radius should not be carried so low as to divide the insertions of the brachialis anticus and biceps.

In some instances, no vessels require ligature, though there may be free general oozing; but most commonly one or two must be tied. In some cases, it is said, that the bleeding has proved extremely troublesome. This, however, I have never seen. After the operation, the limb should be laid upon pillows nearly in the extended position, so that the cut portions of bones are in close approximation with one another. If the excision has been practised through a single straight incision, there will be but little if any gaping of the wound, the flaps falling closely together. If any transverse cuts have been practised, the edges cannot so readily be brought into apposition. At the end of a week or ten days, when granulations have sprung up, it may be put in a slightly bent leather splint, and as the healing process goes on, this may gradually be flexed, until at last it is brought to a right angle. The fibrous union that takes place between the bones will be closer, and a more compact and useful false joint will form, than if the osseous surfaces be too widely separated in the first instance, and be allowed to unite by a lengthened ligamentous tissue. Until the contraction of the cicatrix has fully taken place and the neighboring tissues are quite firm, the joint should be supported by one lateral leather splint, on the inner side of the arm. Much of the success in the result of excision of this, as of other joints, will depend upon the care and attention bestowed on the after-treatment of the case. The position of the parts and the relation of the bones to one another should be scrupulously attended to, bagging of matter prevented, and exuberant granulations repressed. At the same time the patient's strength must be kept up by constant attention to diet, fresh air, &c. In this way good ligamentous union will take place. In a case which I had once the opportunity of examining, about sixteen months after the operation, it was found on dissection that the ends of the bones were rounded and firmly united by a dense ligamentous structure. In this way a most excellent and useful limb will result with but little deformity, as may be seen by the accompanying cut (fig. 227), which was taken nearly two years after operation from a patient of mine. A coachman, whose elbow-joint I excised, was able to drive, to lift a pail of water, and to do all the duties of his employment nearly as well as if the arm had been left in its normal condition.

Fig. 227.



Excision of the wrist is not an operation that has found much favor with surgeons. Most commonly when the carpus is diseased the morbid action rapidly

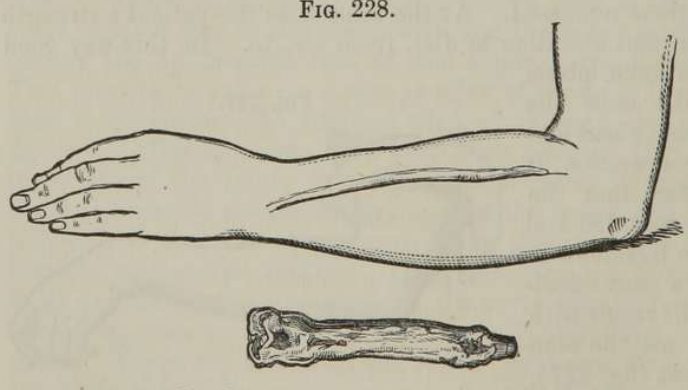
extends with great constitutional irritation to all the small bones that enter into its formation, and although in some cases a few of these may have been successfully taken away, yet methodical excision of the whole of the joint has not been followed by very satisfactory results, having either been attended by persistence of the disease in the soft parts, or followed by a stiff and useless hand and arm. A great objection to excision of the wrist consists in the superficial character of the articulation, and its close connection with the flexor and extensor tendons; hence, when the wound cicatrizes, consolidation of these and of their sheaths is apt to result, and loss of that utility of hand, the preservation of which should be the great object in the performance of the operation, is entailed.

The operative procedure varies according to the amount of disease. When only a few of the carpal bones are diseased, they may readily enough be removed, through an extension of any fistulous openings that exist over them. But when the lower articular ends of the radius and ulna are implicated, a more formal operation is required; and one that is not unattended by some little difficulty, on account of the necessity of saving the extensor tendons of the fingers and thumb. Those tendons, however, that are inserted into the metacarpus, such as the supinators, and the radial and ulnar extensors, may be divided; for, as anchylosis will, under the most favorable circumstances, result, their preservation can be no object.

The surgeon has the choice of two modes of exposing the radio-carpal articulation. A horse-shoe flap, with its convexity downwards, may be made on the dorsal aspect of the joint, and then dissected up without dividing the extensor tendons of the fingers; the articulation is thus freely exposed; the carpal bones may be removed, and the lower ends of the radius and ulna clipped off. Or a longitudinal incision may be made on either side of the joint, the lower ends of the radius and ulna removed, and the carpal bones that are diseased, extracted. Of the two operations I prefer the former, as it gives more room; but even by it, the removal of the bones without cutting across the extensor tendsns is a troublesome procedure. In whatever way performed, excision of the wrist-joint is not a very satisfactory procedure, and in most of the cases in which it has been done, secondary amputation has been required; the wound not healing, or the hand being left in a useless state.

Excision of the ulna or radius.—One or other of the bones of the forearm has occasionally been excised with advantage; leaving a sufficiently useful limb with good power in the hand. Dr. Carnochan, of New York, and Mr. Jones, have successfully excised the whole ulna. Dr. Butt of Virginia, has removed the whole radius.[1] In a case which was under my care about two years ago, I also resected successfully the whole radius with the exception of its articular head, which was sound, and a useful arm, of which the annexed figure is a good representation, was left (fig. 228). These operations do not require any specific rules for their performance; the bone is exposed by a long incision, and then carefully dissected out from the parts amongst which it lies.

Fig. 228.



[1] [The excision performed by Dr. Butt was not that of the radius, as stated in the text, but a resection of the ulna. The report of the case is somewhat confused, and it seems as if only the lower three-fourths of the bone were removed. See *Philadelphia Journal of the Medical and Physical Sciences, for* 1825.]

Conservative surgery of the hand. — In the removal of diseased or injured portions of the hand, it is, as a general rule, of the greatest consequence to sacrifice as little as possible of the healthy or uninjured structures. In all operations on the hand, indeed, we must have two great principles in view, — the preservation of the utility of the member, and the maintenance, so far as practicable, of its symmetry. Utility is necessarily the primary consideration ; but if a part is not useful, it may, as in the case of the head of the middle metacarpal bone in amputation of the corresponding finger, be sacrificed for the purpose of preserving the symmetry of the maimed limb. The hand is the organ of *prehension* and of *touch*, and in all operations applied to it we should endeavor as far as practicable to maintain its efficiency in both these respects. It is also of importance to bear in mind that two great classes of actions can be carried out by the hand ; those that require force, and those that require delicacy of manipulation rather than strength. By a surgical operation we may sometimes succeed in preserving one, though we are compelled to sacrifice the other, and in this respect, our procedure should be a good deal influenced by the occupation of the patient. Thus, by partial excision, we may leave a hand that would enable a clerk to hold his pen, but that would be almost useless to a laborer or blacksmith.

In looking at the hand in a surgical point of view, we may consider it as being composed of two constituents — the hand proper, and the thumb ; the thumb being an accessory hand, an opponent to the rest of the member, through the medium of which the movements of ab- and adduction are chiefly performed, and without which the member is susceptible of a comparatively limited utility, being capable of little beyond flexion and extension. Hence the thumb is of equal importance to the rest of the hand, and the preservation of its three bones is as much to be considered as that of the remaining sixteen that enter into the conformation of the metacarpus and fingers. In all cases of injury or disease implicating the thumb, every effort ought to be made for its preservation. Even if it be left stiffened and incapable of flexion, it will be a most useful opponent to the rest of the hand. Should it be found necessary to shorten it, care must be taken that as little curtailment as possible be practised — a portion of a phalanx, or its metacarpal bone even, is of essential utility in giving strength and breadth of grasp to the hand. In cases of disease, a very useful member may be left by the removal of a portion or the whole of the ungual phalanx, of the metacarpo-phalangeal articulation, or even by the excision of the metacarpal bone, the phalanges being left behind. These various operations are easy of performance ; an incision through the diseased and disorganized soft parts will expose the necrosed bone or carious joint, which must be removed by cutting-pliers or a narrow saw.

When the thumb has been forced back or badly lacerated by powder-flask or gun-barrel explosions, it may often be saved by being replaced and maintained in position on a splint, with light water-dressing over it ; and should amputation be required, it must be done in accordance with the rule just mentioned, viz., of saving as much as possible of the injured part.

In the conservative surgery of the fingers, the preservation of flexion and extension in the part left, is the main thing to be aimed at ; a rigid stump is always in the way. The preservation of these movements becomes more important in proportion as the palm is approached. It is of more consequence that the proximal phalanx, which carries the rest with it, should be capable of being bent into the palm, than that the distal can be flexed on the second. If the proximal phalanx can be bent down, a very small degree of movement in the distal one will be sufficient to furnish pliability enough in the finger to make it a useful member ; but if the proximal one is stiffened, no amount of mobility in the distal phalanx can make it useful.

In preserving these movements it is necessary to be particularly careful of the

sheaths of the tendons. If they be in any way opened or injured, it will generally be found either that the tendon sloughs, or that it becomes consolidated, and matted to its sheath in such a way that all movement is lost, or at least greatly impaired.

The only phalanx that can be excised with advantage is the distal one. It often happens in the destructive disorganization that results from whitlow, that this necroses; when, instead of amputating the end of the finger, it may be removed by an incision on its palmar aspect. Disease of the phalangeal articulations usually leads to amputation of the affected finger. The rules for performing these various operations have already been laid down at pp. 25–26, to which I must refer the reader.

Resection of the metacarpal bone, either of the thumb or index finger, without the removal of the corresponding digit, is occasionally required, more particularly in cases of injury; and may readily be done by making a longitudinal incision over the dorsal aspect of the bone to be removed, carefully detaching it from surrounding parts by keeping the edge of the knife close against the bone, avoiding the tendons, and then, either disarticulating, or, what is preferable, cutting across the neck of the carpal end of the bone, turning it out, and separating it from any distal attachments it may retain. After the removal of the metacarpal bone of the index finger in this way, but very little deformity results.

Conservative surgery of the lower extremity. — In all conservative operations that are practised on the lower extremity, it is of essential importance that a good basis of support, of sufficient length and stability, is left to the body. These operations differ thus in some important respects from those that are practised on the upper extremity. In the latter, the preservation of the hand, even though in a mutilated condition, is the thing that the surgeon aims at; and provided this be attained, it matters comparatively little how much the arm may be shortened or impaired in power. In the lower extremity, however, strength, length, and solidity are essential to the patient's comfort; and, unless these can be secured, his interests are better considered by the removal of the limb, and the adaptation of some artificial contrivance, than by his being left with a shortened, wasted, and crippled member, which is unequal to support the weight of the body.

Resections of the Foot. — In looking at the division of the foot into its three great component parts — toes, metatarsus, and tarsus, — we shall perceive that firmness of gait is given by the foot resting on the heel behind, and the ball in front, formed by the projection of the broad line of the metatarso-phalangeal articulations, more particularly that of the great toe, — whilst elasticity is communicated to the tread by the play of the toes and metatarsal bones. The elasticity of the foot may be lost without any very serious inconvenience to the patient; but the preservation of stability and firmness of gait are of essential importance; and, as these are secured by the heel, the ball of the great toe, and the breadth of the anterior part of the foot, these are the most important parts to preserve in all resections of this part of the body.

The foot is frequently the seat of strumous disease; to this it is disposed by the alternations of temperature to which it is subjected, its liability to sprains and injuries, and by the cancellous and spongy structure of its bones, together with its extensive articulating surfaces. When affected by strumous inflammation it becomes painful, the patient being unable to bear upon the toes or anterior ball of the foot. Swelling takes place of a uniform character, tenderness at some point opposite the bones or articulations that are chiefly involved, and eventually abscess forms, leaving sinuses through which the probe passes down upon softened and carious bone. These evidences of disease are usually much marked about the dorsum and sides, the sole being often comparatively free from disease; an important point in reference to operation.

In studying the conservative surgery of the foot, it must be borne in mind that at least six distinct and separate articulations exist between the different tarsal bones, and between these and the metatarsus; that any one of them may be distinctly and separately affected, and that, as they vary very greatly in size, complexity, and importance, the danger to the foot will differ much according to the articulation that is the seat of disease; it will also, as a general rule, be found that the prospect of successful excision of tarsal or metatarsal bones, will be much influenced according as the operation opens up large and complicated synovial surfaces common to many of the bones, or is confined to a synovial surface of more limited extent. The smaller synovial membranes, disease of which is seldom attended by serious risk to the whole foot, and which readily admits of the application of excision, usually with removal of the contiguous bones, are the following: — 1st, that between the metatarsal bone of the great toe and the internal cuneiform; 2nd, that between the fourth and fifth metatarsal bones and the cuboid; 3rd, the calcaneo-cuboid; 4th, the posterior calcaneo-astragaloid. The remaining two synovial membranes are of large size and complex in their arrangements, dipping, as they do, deeply into the foot, and corresponding to the articular surfaces of many bones, their disease is always of serious, and often fatal importance to the preservation of the member. They are, 1st, that membrane which extends between the astragalus and scaphoid into the anterior calcaneo-astragaloid articulation, and 2nd, the large and complex anterior tarsal synovial membrane, which comes into relation with the scaphoid, the three cuneiform bones, the cuboid, and the second and third metatarsal bones.

Strumous disease may commence either in the bones, or in the articulations of the foot. The bones that are most frequently the seat of primary disease are, the calcaneum, the astragalus, the scaphoid, the cuboid, and the metatarsal bone of the great toe. When limited to one or two of these bones, excision is usually practicable; but when the morbid action extends, through the influence of the connecting articulations, to other bones of the tarsus or metatarsus, partial amputation will be required.

Primary disease of the articulations of the foot is a frequent cause of operation, and the particular operation required will in a great measure depend upon the extent of the implication of the synovial membranes of the foot. When the calcaneo-astragaloid or the calcaneo-cuboid articulations are alone affected, resection of the bones and joints implicated will often be attended by very satisfactory results; but when the large anterior tarsal synovial membrane is in a state of chronic disease, either as the result of primary morbid action set up in it, or secondarily to diseases of the scaphoid, the cuneiform, or of either of the metatarsal bones connected with it, then resection is scarcely admissible, and Chopart's amputation offers the best means of relief. The inflammation of the large and complicated anterior tarsal synovial membrane commonly commences in disease of the scaphoid. It may usually readily enough be recognized in its earlier stages by the pain and swelling that take place across the line of articulation between the scaphoid and cuneiform bones, the pain being greatly increased by bending the foot down, and extending across the whole breadth of the foot. For, although usually most severe at the inner side, which is the first affected, yet the external section of this complicated articulation, that between the external cuneiform and the cuboid, becoming involved, causes suffering to be experienced on the outer side of the foot as well. In the more advanced stages of this particular disease, the foot assumes a remarkable bulbous or clubbed appearance; the symmetry of the heel and the outline of the ankle is unimpaired, but the forepart and dorsum of the foot are greatly swollen, glazed, and possibly perforated by sinuses discharging thin unhealthy pus. I look upon this disease of the anterior tarsal synovial membrane as a distinct affection of the

foot, requiring to be diagnosed from the other strumous inflammations, and in its advanced stages requiring Chopart's amputation.

The phalanges and articulations of the toes seldom require resection; as a general rule their amputation is preferable. The only case that I am acquainted with in which resection of a phalanx is required, is when an exostosis has formed under the nail of the toe, pushing it up, when the removal of that portion of bone from which it springs, is the best course to pursue.

The great toe not unfrequently requires removal in whole or in part; but, entering largely as it does into the formation of the arch of the foot, no more of it should be taken away than is absolutely necessary. It is especially of importance that the ball of the great toe be, if possible, preserved; and occasionally this may be effected by excision of the metatarso-phalangeal articulation rather than by the amputation of the member. With regard to the removal of the toe and its metatarsal bone, I must refer to p. 55. Whenever it is practicable the proximal end of the bone should be saved, in order that the insertion of the tendon of the peroneus longus may be preserved.

The other metatarsal bones with their toes occasionally require removal. This is more particularly the case with the fifth. The middle metatarsal bones cannot advantageously be taken away, leaving merely the first and last; but the two, three, or even the whole four of the external metatarsal bones may be advantageously resected, and a useful foot be left. Mr. A. Key has recorded a case in which, in consequence of injury, he amputated the four outer metatarsal bones, the cuboid, and the external and middle cuneiform, leaving merely the line of bones supporting the great toe. The first metatarsal bone was left, supported only by the slender articular surface of the internal cuneiform, but it soon got firmer attachments, and a very good foot resulted, by which the patient retained in a great measure his elasticity of tread.

The *os calcis*, from its exposed situation, large size, and spongy structure, is more frequently the seat of caries and necrosis than any of the other tarsal bones; and very commonly the morbid action is limited to this bone; in other instances it extends into the calcaneo-astragaloid or calcaneo-cuboid articulations.

When the disease is situated in the posterior or lateral parts of the bone, the neighboring articulations are seldom involved, and then the removal of the morbid structures by gouging will usually succeed in effecting a cure. I have frequently had occasion in this way to scoop out great portions, sometimes the whole of the interior of the calcaneum, with the most excellent results.

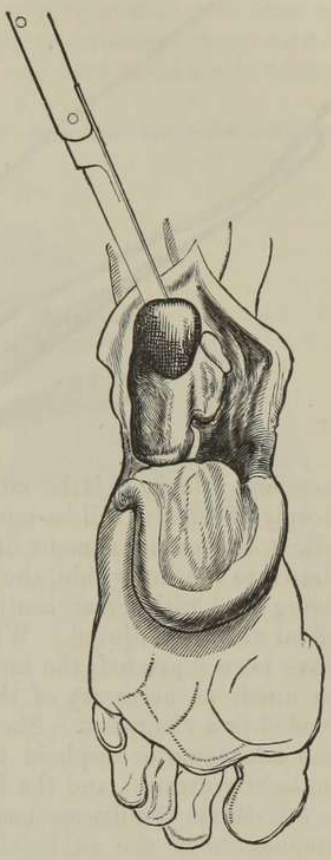
If the upper or anterior portions of the bone are diseased, so as to involve its articulations with the astragalus and cuboid, its excision should be practised. The operation is a very successful one, and leaves a flat but useful foot. Occasionally, however, after the removal of the bone, disease is set up in the neighboring parts requiring amputation; this I have seen more than once happen; and, of 10 cases collected by Mr. M. Greenhow, it became requisite in 2 eventually to remove the foot.

The excision of the os calcis is usually performed by turning a heel-flap back as in disarticulations at the ankle joint, and then carrying incisions forward into the sole of the foot, by which another flap is turned up, and thus the calcaneo-cuboid articulation exposed and opened (fig. 30); after which the knife is carried between the astragalus and calcaneum, and that bone detached. By this operation the sole of the foot is somewhat extensively incised and cicatrices are left over the heel.

In order to avoid this inconvenience, I have found that disarticulation of the os calcis may readily be performed in the following way. The patient lying on his face, a horse-shoe incision is carried from a little in front of the calcaneo-cuboid articulation round the heel, along the sides of the foot, to

a corresponding point on the opposite side. The elliptic flap thus formed is dissected up, the knife being carried close to the bone, and the whole under surface of the os calcis thus exposed. A perpendicular incision about two inches in length is then made behind the heel, through the tendo Achillis in the mid line and into the horizontal one. The tendon is then detached from its insertion, and the two lateral flaps dissected up, the knife being kept close to the bones from which the soft parts are well cleared (fig. 229). The blade is then carried over the upper and posterior part of the os calcis, the articulation opened, the interosseous ligaments divided, and then by a few touches with the point, the bone is detached from its connections with the cuboid, which, together with the astragalus, must then be examined, and if any disease is met with the gouge should be applied. By this operation all injury to the sole is avoided, and the open angle of the wound being the most dependent, a ready outlet is afforded for the discharges.

Fig. 229.



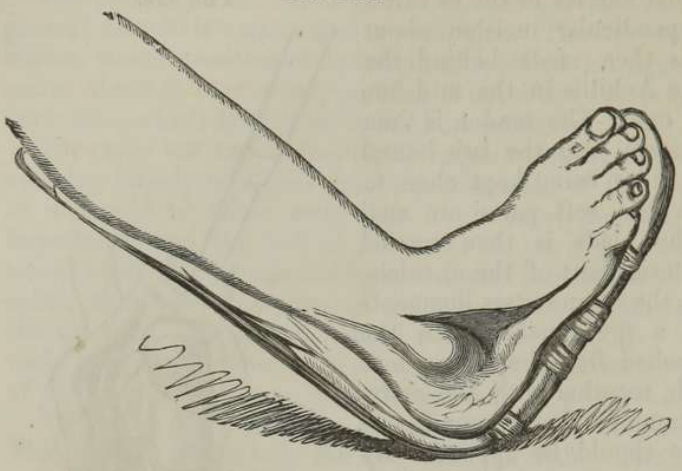
The astragalus though often diseased is rarely affected without the neighboring bones participating in the morbid action. It is so wedged in between the arch of the malleoli above, the calcaneum below, and the tarsal bones in front, that it is not long before disease spreads from it to the contiguous articulations and osseous structures. Disease primarily originating in the astragalus may spread in three directions: upwards into the ankle-joint, downwards to the calcaneum, and forwards to the scaphoid, and thence through the large anterior synovial membrane to the rest of the tarsal bones. The treatment will vary according to the direction and extent of the disease. It may be arranged under four heads.

1st. When the astragalus alone is diseased, either gouging or excision may be required. If the morbid action be limited to the outer side of the bone, or to its head, it is possible that by freely opening up the sinuses and applying the gouge, the caries may be entirely removed. But this operation is not so satisfactory here as elsewhere in the foot, as it is by no means easy to avoid opening the astragalo-scaphoid articulation, and if this is done, disease will almost inevitably extend through the tarsal articulations. Excision of the astragalus alone, though sometimes required for disease, is perhaps more frequently called for in those cases of compound dislocation in which the bone, having been thrown out of its bed, eventually becomes carious or necroses. The operation may readily enough be done by making an incision across the outer and anterior aspect of the ankle, exposing the bone, cutting across its neck with pliers, and then with strong forceps forcibly elevating it from its bed and detaching it by the cautious application of the knife, more particularly to the inner side, where the plantar arteries are in danger. The result of this operation is very satisfactory, a good and movable articulation may be left between the malleoli and calcaneum, and the limb is but little shortened.

2d. When the disease has extended from the astragalus to the malleolar arch, excision of the ankle-joint will be required. This operation may conveniently be performed in the following way. A semi-lunar incision about four

inches in length should be made along the outer and anterior aspect of the joint, round the lower border of the external malleolus (fig. 230), and should be carried sufficiently forwards to give space without dividing the extensor tendons or the dorsal artery. The peroneal tendons having been divided, the lower end of the fibula should be cut across and detached. The astragalus which will now be exposed, should then be separated from its connections, which, if it be much diseased, may usually be readily done. If not deeply affected it will be more firmly held, and should be then cut across with pliers, and each fragment lifted out of its bed. The foot should now be well drawn to the inner side, the lower end of the tibia carefully isolated, the knife being used with great caution and kept close to the bone, lest the posterior tibial artery be injured. When the ligamentous structures attached to the bone have been separated, the inner malleolus may be cut off with bone forceps, and as much as necessary of the lower end of the tibia removed with a narrow-bladed or a chain-saw. Should there be any disease in the articular surfaces of the calcaneum or scaphoid this must be gouged away. The part should then be lightly dressed, and the limb placed on a Liston's splint.

Fig. 230.



3d. When the disease has extended to the calcaneum from the astragalus, amputation at the ankle-joint may be required, or should the surgeon prefer it, he may excise both the diseased bones, as has been successfully done by Mr. T. Wakley.

4th. If the disease has extended from the astragalus to the scaphoid, and thence into the anterior range of tarsal joints, the foot will have become so extensively disorganized, that partial resection will be of little or no service, and disarticulation of the ankle-joint should be practised.

Excision of the cuboid bone either in whole or in part may be required; when the whole of the bone is taken away, the fifth metatarsal bone with the little toe will probably also require removal.

The scaphoid is very commonly the seat of primary disease, and as this bone is connected in front with the large tarsal synovial membrane and posteriorly with that which is common to the calcaneo-astragaloid and astragalo-scaphoid articulations, the greater part of the tarsus is apt to become speedily involved in the morbid action. The extent of this implication is such that excision of the primarily diseased bone would probably seldom be attended by much benefit, and Chopart's amputation or disarticulution at the ankle-joint becomes necessary. Next to disease of the astragalus, I look upon strumous inflammation of the scaphoid as most destructive to the integrity of the foot.

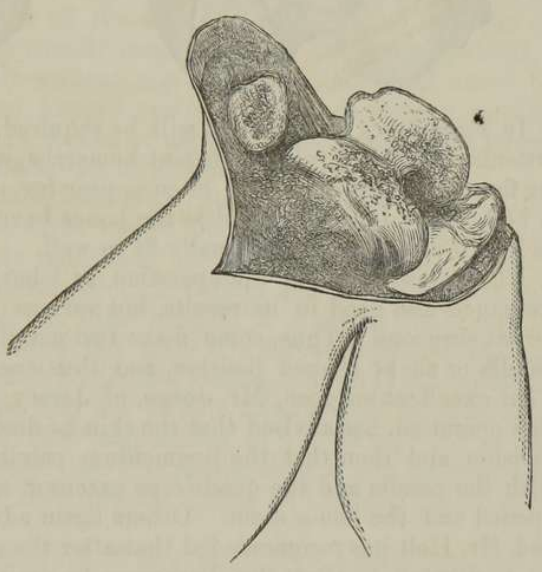
In chronic disease of the ankle and tarsal bones, it will occasionally happen that an excellent and useful limb may be left after excision of a less formidable kind than those just described. In a lad who was some time since under my care with very extensive disease of these parts of old standing, I removed the lower three inches of the fibula, gouged away a considerable portion of the end of the tibia, and of the astragalus, calcaneum, and cuboid, removing a whole

handful of carious bone. Yet a perfect cure resulted, the patient recovering with a strong and useful foot.

The malleoli alone seldom require resection. Should either of them do so, the operation may readily enough be accomplished,—in the outer malleolus, by dividing the bone with cutting pliers, but in the inner malleolus, more care is required in avoiding the flexor tendons, the artery, and nerve, and the bone had better be cut across with a chain-saw.

Excision of the knee-joint may be required either as a substitute for amputation in cases of extensive disease and disorganization of the articulation, or may be practised in some cases of deformity resulting from old disease or injury by which the limb has been rendered useless. This operation, originally practised at the close of the last century by Park, Filkin, and the Moreaus, fell into disfavor until it was revived in 1850, by Mr. Fergusson, since which time it has been extensively practised.

Fig. 231.



Excision of the knee-joint may be performed by making a horse-shoe incision with the convexity downwards, extending from the side of one condyle of the femur across the tuberosity of the tibia to a corresponding point on the opposite condyle (fig. 231). By this incision, the ligamentum patellæ is divided, and that bone turned up in the elliptical flap; the crucial ligaments are then to be cut across, any remaining lateral attachments divided, and the bones cleared for the saw. In doing this the limb must be forcibly flexed, and the knife carefully applied to the posterior part of the head of the tibia; for this purpose a blunt-pointed resection knife is the best. The articular surfaces must now be sawn off. This may best be done by Butcher's saw. The lower end of the femur should first be removed, and then a slice taken off the tibia by cutting from behind forwards, the blade of the saw being turned horizontally; care should be taken not to remove more bone than is absolutely necessary, lest the limb be too much shortened. As not unfrequently happens, carious cavities will be found extending below the level of the section that has been made. When this is the case, it is better to apply the gouge to them than to saw the bone below their level. It is usually sufficient to remove from one-third to three-fourths of an inch of the tibia, and about one inch to an inch and a half of the femur (figs. 232 and 233). Should, however, the operation be required for disease of the limb consequent upon the deformity resulting from badly reduced fractures or dislocations about the knee, as has been done successfully by Mr. Humphry of Cambridge, it may be necessary in order to get the limb into good position, to remove a wedge-shaped piece from one of the bones.

If the patella is much diseased, it must be removed; if it be only slightly carious, it may be scraped or gouged out, and in accordance with that principle of conservative surgery by which no sound part is removed, it should be left, becoming consolidated with and strengthening the joint. The anterior articular surface of the femur, which extends some way up the fore-part of that bone,

may advantageously be sliced off, so as to leave an osseous surface instead of a cartilaginous one, for the patella to attach itself to.

Fig. 232.

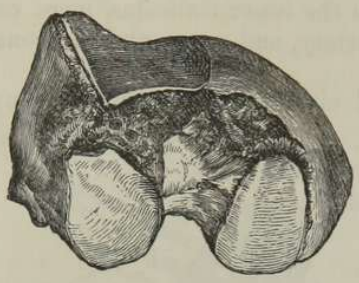


Fig. 233.

In some cases no ligatures will be required, but usually two or three of the articular arteries furnish sufficient hemorrhage to require restraint. The patellar flap when laid down will often appear inconveniently long and thick, but it is better not to curtail it, unless the bones have been shortened more than usual, as it will contract and eventually fit in well.

I have always found the operation as I have just described it, easy of performance and good in its results, but various modifications are adopted by different surgeons. Thus, some make two parallel incisions on either side of the patella or an H shaped incision, and thus open the articulation from the side. That excellent surgeon, Mr. Jones, of Jersey, who has had great experience in this operation, has advised that the skin be dissected up by means of a semilunar incision, and then that the ligamentum patellæ be preserved by being pushed with the patella and the quadriceps extensor tendon to one side, the joint then opened and the bones sawn. Others again advise that the patella be removed, and Mr. Holt has recommended that after the excision the soft parts of the ham be perforated to allow the discharges to drain through. The successful issue of the operation will mainly depend on the care taken in the after-treatment of the case.

After the operation, the limb should be at once put up securely in a Liston's splint, and well-supported. During the after-treatment, when granulations spring up, it may most conveniently be placed in a long leather trough, extending from *beyond* the foot to the pelvis, and well padded, particular attention being paid to the position of the limb, and especially to the prevention of any bowing outwards which is apt to take place. In order to prevent displacement it has been proposed to divide the hamstring tendons; this, however, I have never found necessary, nor does it seem to me to be advisable to complicate the operation by such an addition to it. The protuberance of the flap, if at all excessive, may be diminished by the pressure of a many-tailed bandage. In this way osseous anchylosis will ensue, and a good and useful straight limb result. In two cases I have succeeded in getting a good limb with a partially movable joint; both these cases were in children, and I am disposed to think that in young patients this result may often be satisfactorily attained. In adults, however, osseous anchylosis should always be aimed at.

In determining the propriety of performing this operation, there are two points to be considered:—

1st. The danger attending it; and 2d, the nature of the result.

The danger attending excision of the knee-joint is not great when compared to that which follows the operation, amputation of the thigh, instead of which it is practised, or indeed capital operations generally. According to Mr. Butcher, the operation has been performed 82 times since its revival in 1850 up to 1857. Of these 15 proved fatal, and in 8 amputation of the thigh was required, of which 1 case had a fatal issue. In some instances there is reason

to believe that the unsuccessful result was owing to want of due attention to the after-treatment of the case. I think, therefore, we are warranted in concluding that this operation, though serious, is not attended by any very great amount of risk to the patient.

The 2d point that has to be determined, is as to the utility of the limb after the operation, the propriety of performing which, depends in a great degree upon whether the limb that is left is more useful than an artificial one.

On this point, the result of recorded cases is in favor of the operation. In one of Mr. Park's cases, operated on in 1783, that surgeon states that the patient, a sailor, seven years after the operation, "was able to go aloft with considerable agility, and to perform all the duties of a seaman." In some of the later cases the result has been equally good. One of Mr. Jones' patients, a boy, "could run and walk quickly without any aid of a stick, could stand on the limb alone, and pirouetted and hopped two or three yards without putting the sound limb to the ground." In several of my own cases an excellent strong and straight limb has been left, useful for all ordinary purposes.

After the operation, osseous anchylosis takes place with a firm cicatrix, the limb is shortened by from two to three inches, but by means of a high-heeled shoe this inconvenience is greatly remedied. It has been urged against the excision of the knee-joint that convalescence is tedious and prolonged, but this argument can with justice have but little weight; if a useful limb can be preserved to the patient, it can matter but little if a few additional weeks are devoted to the procedure by which it is obtained;—and, indeed, it is a question, whether in many cases the patient may not be able to walk just as soon after the excision of the knee-joint as after amputation of the thigh; for as has been very properly remarked, though the amputation wound may be healed in three or four weeks, it may be as many months before an artificial limb can be worn.

Excision of the head of the femur has of late years been a good deal talked about and practised in some cases of hip-joint disease. This operation may, however, most conveniently be considered in connection with that affection (p. 657).

Amputation in joint-diseases. — In those cases in which excision of the diseased joint is not advisable, in consequence of the acute character of the articular disease, the existence not only of considerable suppuration, but of great local and constitutional irritation, or the peculiar nature of the joint affected, amputation may be the sole resource left to the surgeon. It is especially in articular disease of the fingers and toes, of the tarsus, carpus, ankle, and knee, that this operation is required; and though much less frequently practised now than formerly, yet the cases of destructive disease of joints requiring amputation are amongst the most frequent in operative surgery, and will doubtless continue to be so. The surgeon, however, must be careful whilst he avoids continuing to make ineffectual attempts to save the limb at the great hazard of the patient's life, not to amputate until it is clear that all other means have failed, the patient continuing to lose ground, so that a further perseverance in local and constitutional treatment would probably end in his death, excision not being practicable. So far from amputation being an opprobrium to surgery in such cases as these, I look upon it as one of the greatest triumphs of our art, that by a simple and easy operation which removes the spoiled and useless limb, the life of the patient may be saved, and his health speedily restored. It commonly happens that a patient who has been racked with pain, and been wasting in body for weeks before the local source of irritation was removed, sleeps soundly the night after the operation, and rapidly gains flesh and strength.

As phthisis not unfrequently co-exists with the advanced forms of strumous joints, the question of amputation under these circumstances becomes one of

very considerable importance. If the phthisis be rapidly progressing, and there be a strong hereditary tendency to the disease, or if it have advanced to softening of the lung, and the formation of vomica, it would be useless to operate. If, however, the phthisis be of a very slight and incipient character, and be apparently due to the local irritation of and discharge from the diseased joint, to the confinement to bed that it necessitates, and to the general depravation of health that ensues, amputation may not only be safely, but advantageously practised; and I have performed it in many such cases, to the manifest advantage of the patient.

LOOSE CARTILAGES IN JOINTS.

It sometimes happens that in the interior of the joint the synovial membrane assumes a warty condition, as the result of chronic irritation of the articulation. For this condition, which gives rise to occasional uneasiness and puffiness about the joint, with a crackling or creaking sensation when it is moved, but little can be done beyond the application of discutient plasters and the use of elastic bandages.

Loose cartilages, as they are termed, are not unfrequently met with in the different articulations. These in many cases are not truly cartilaginous, but appear to be composed of masses of condensed and indurated fibroid tissue, not very dissimilar in structure to the warty synovial membrane just referred to. In other cases, however, it is probable that they may be of a truly cartilaginous formation. These bodies vary in size from a barley-corn to a chesnut; when small, being rounded in shape; when large, being somewhat flattened or depressed on the surface; they are smooth, shining, and usually of a yellowish or greyish white color. They are most frequently met with in the knee, but not uncommonly occur in the elbow or the joint of the lower jaw, and occasionally in the shoulder. Most commonly only one is found, but their number may range from this up to fifty or sixty.

They commonly give rise to very severe pain in particular movements of the limb. This comes on suddenly, prevents the patient either straightening or flexing the joint completely, and is often so intense as to cause faintness or sickness. It is usually followed by a degree of synovial inflammation and by relaxation of the ligaments. These attacks of pain and of sudden irritability of the part come on at varying intervals, as the result of movements of it; they commonly happen in the knee whilst the patient is walking. It is difficult to say to what this severe pain is due. Richet thinks it may be owing to the synovial membrane being pinched between the foreign body and one of the articular surfaces. In some cases the loose cartilage can be felt by carrying the finger over the joint, when it may be detected under the capsule, slipping back perhaps when pressure is exercised upon it.

The *treatment* consists in supporting the joint with an elastic bandage or knee-cap, so as to limit its movements, and thus prevent the liability to the recurrence of the attacks of pain. Any inflammatory action that has been excited requires to be subdued by proper antiphlogistic treatment.

If it occasion great and frequent suffering, so as to interfere seriously with the vitality of the limb, and if the cartilage appear to be of large size, and single, means may be taken for its extraction. No operation, however, should be undertaken with this view so long as the joint is in an irritated state, as the result of a recent attack of pain; this must be first subdued, and then the operation may be proceeded with. The extraction may be effected by directing the patient in the first instance to make those movements by which he usually gets the cartilage fixed in the joint. So soon as the surgeon feels it (as this operation is commonly required in the knee) he should push it to one side of the patella, where he must fix it firmly with his fore-finger and thumb; he

then draws the skin covering it to one side, so as to make it tense, and cuts directly down upon the cartilage by a sufficiently free incision to allow of its escape. The wound which, when the skin is relaxed, will be somewhat valvular, is then closed by a strip of plaster, and the limb kept at rest for a few days until it has united. Severe inflammation of the joint less frequently follows this operation than might have been expected, the synovial membrane having probably undergone some modification of action that renders it little liable to this process. It does however happen that acute synovitis may set in, and this has terminated in suppuration of the joint, requiring amputation, or leading to anchylosis; hence it is an operation that should not lightly be undertaken.

It has been proposed by M. Goyrand, in order to obviate the dangers of an external wound into the joint, to remove the loose cartilage by subcutaneous section; this he proposes to accomplish in a way that I have seen practised by Mr. Liston; viz., by passing a tenotome obliquely under the skin after fixing the foreign body in the way that has already been described, dividing the synovial membrane freely, and then squeezing the cartilage into the cellular tissue outside the joint, where it may be allowed to remain until removed by a fresh incision after that in the synovial membrane has healed, or left and be eventually taken up by the absorbents of the part.

A useful modification of this method consists in fixing the loose cartilage, dividing the capsule subcutaneously over it, and then pressing the foreign body into the opening thus made, retaining it there by a compress and plasters. Adhesion speedily ensues, and eventual absorption of the loose cartilage.

NEURALGIA OF JOINTS.

Severe pain may occur in joints without organic disease, either from the pressure on a nerve leading to the articulation or distributed in its vicinity, or from some neuralgic condition of the joint itself. Thus there may be severe pain in the knee in consequence of pressure being exercised upon the obturator nerve, or the joint generally may be excessively painful — especially in girls or young women — owing to some hysterical condition or uterine irritation, the nature of which in many cases is not very clear. It is this class of cases, occurring in hysterical females, that should especially be considered as neuralgia of the joints, to which the attention of the profession has principally been directed by the labors of Sir B. Brodie.

In these cases it is generally found that the hip, knee, ankle, or shoulder is the joint affected — the hip and the knee being especially liable to it — severe pain is complained of in it; and it is rendered comparatively useless, often with a good deal of distortion. On examination it will be found that the pain, which is commonly very severe, is superficial and cutaneous, not existing in the interior of the articulation or increased by pressure of the articular surfaces against one another, and is not strictly confined to the joint, but radiates for some distance around it. This pain is often intermittent in its character, and is frequently associated with neuralgia elsewhere, as in the spine; and not unfrequently with uterine irritation or disease. At the same time it will be observed that all the signs that ought to accompany a severe attack of inflammation in a joint, such as would be attended by a corresponding amount of pain, are absent; there being no painful startlings of the limb at night, or constitutional fever and irritation; and the suffering being increased by causes, such as mental and emotional disturbance, that do not influence organic disease. Attention to these various circumstances will usually enable the surgeon to diagnose the nature of the attack without much difficulty; the only cases in which he will really experience any, being those in which the tissues around the joint have been thickened, indurated, and altered in their characters by the

application of issues, moxæ, &c.; or by some slight articular ties having at some time existed, but been cured.

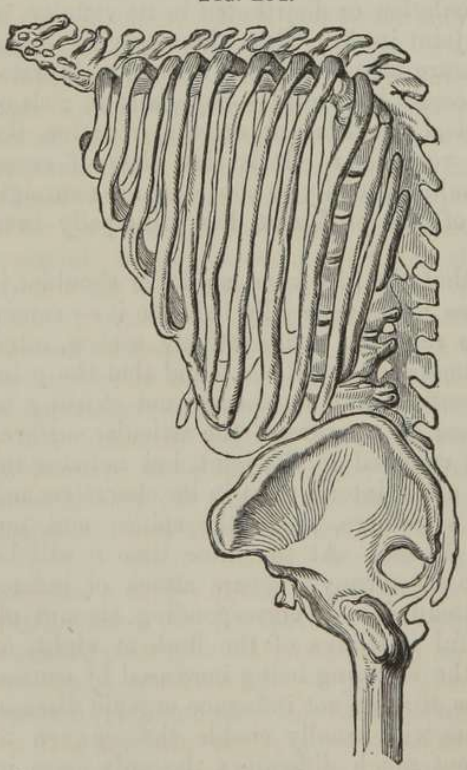
The *treatment* must be of a general character, directed especially to re-establish a healthy condition of the uterine organs. If there be amenorrhœa, and anemia, aloëtics, and the preparations of iron must be given; if uterine irritation or ulceration exist, this must be removed by proper local means, and the general health attended to. The most efficient treatment that can be directed to the affected joint, is, I think, the application of cold douches and the employment of electro-magnetism, which I have found to cure cases in which all other means had failed; the application of atropine and aconite may be of service to allay the pain when especially severe.

CHAPTER XLV.

DISEASES OF THE SPINE.

Caries of the vertebræ.—This disease, which consists, in its full development, in destruction of the bodies of the vertebræ, with disintegration of the intervertebral fibro-cartilage, most commonly occurs in young children, sometimes but a few months old; but is not unfrequently met with at all ages up to that of thirty. It is always, I believe, a strumous affection, consisting essentially in tubercular infiltration of the bodies of the vertebræ, followed, as commonly happens, in this morbid condition, by congestion, caries, or necrosis of the osseous tissue that is in contact with, or the seat of, the deposit. In consequence of these changes going on in the bodies of the vertebræ, they become thinned, eroded, and gradually hollowed out anteriorly. The disease is usually limited to the bodies of the vertebræ, leaving the spines, the arches, and the tubercles unaffected; but in some instances even these structures, which are of a more compact character, become eventually implicated. In this way the bodies of from three to six or eight of the vertebræ may be destroyed, the corresponding intervertebral fibro-cartilages, which derive their supply from the contiguous bones, becoming disorganized, as these undergo destruction. These changes commonly occur about the middle dorsal vertebræ; if extensive, they may implicate the upper or lower dorsal, or upper lumbar, and always give rise to angular projection backwards of the diseased

Fig. 234.



part of the spine, corresponding in extent to the amount of destruction of the vertebræ (fig. 234). The mechanism of this excurvation, which is the most marked feature in this disease, is easily understood by reference to the pathology of the affection. The bodies of the vertebræ being thinned and weakened, at last give way under the pressure of the weight of the upper part of the body, and the remains of the disintegrated bodies being fused together, cause the upper part to bend over, and the spines to project posteriorly. The degree of bending forwards and of posterior excurvation corresponds to the amount of the destruction of the bodies of the vertebræ. It is seldom that the spinal marrow becomes compressed or injured during the progress of this disease. In some cases, however, more particularly in adults, it becomes softened opposite the seat of curvature, and thus paralysis may be occasioned.

The *symptoms* of the disease, when it is fully developed, are well marked; but in children it often comes on very insidiously, commencing with a degree of weakness in the back, with an inability to stand upright, and with a tendency to lean the body forwards, or to support it by resting the hands on the knees, or seizing hold of anything that will serve as a temporary support. On examination, a few of the spines about the middle of the back will be found to be a little more prominent than the rest, and on pressing or tapping upon them pain will be complained of. The child usually becomes stunted in its growth, and if the disease is not arrested by proper treatment, continues more or less hump- or round-backed for life. In other cases it will run on to the formation of abscess, as will immediately be described, strumous manifestations occurring elsewhere, and death eventually resulting.

In adults, the symptoms will vary somewhat according to the seat of the affection. It is most dangerous and rapidly fatal when the cervical vertebræ are implicated, for, as the bodies of these are shallow, caries readily penetrates to the spinal canal, and the cord may thus be irritated. When the dorsal or lumbar vertebræ become diseased, the affection is not of so immediately serious a character to the life, though it may be to the figure, of the patient. In adults it often commences with pain in the loins or back, apparently of a rheumatic character, shooting round the body or down the thighs. On examining the spine, which feels weak to the patient, tenderness on pressure or on tapping will be experienced at one point, and he will wince when a sponge wrung out of hot water is applied to this part, although there may be no appearance of excurvation. The lower limbs now become weak, and the patient walks with a peculiar shuffling, tottering gait, the legs being outspread, and the feet turned out. The weakness of the limbs is especially marked in going upstairs, and may be tested by directing the patient to stand unsupported on one leg, and raise the other so as to place the foot upon the seat of a chair, which he will probably be unable to do. The deformity of the spine now slowly increases, the patient becomes unable to stand, and spasms of the muscles of the lower extremity come on, together with a tendency to relaxation of the sphincter ani, and retention of urine. Abscess now commonly makes its appearance, and in some cases it occurs before any of the other signs, except pain and weakness of the spine, but certainly before any deformity has taken place. When the abscess forms, as Mr. Stanley has observed, the pain and irritation of the spinal cord are usually lessened for a time.

It must not, however, be supposed that abscess necessarily forms in all cases; indeed, the formation of matter will, I believe, chiefly depend upon whether the disease of the vertebræ be tuberculous or not. Simple congestive or inflammatory caries of the spine may take place to a very considerable extent, and yet no suppuration occur, the bodies of the vertebræ undergoing erosion, and absorption, and coalescing so as to become fused together into one soft and friable mass of bone, across which bridges of osseous tissue are sometimes thrown out, so as to strengthen the otherwise weakened spine. In these cases

masses of porcellanous deposit will not unfrequently be found intermixed with and adherent to the carious bone. Indeed, this anchylosis and fusion of the bodies of the diseased vertebræ may be looked upon as the natural mode of cure of angular curvature of the spine; the only way in which it can take place when once it has advanced to any considerable extent.

When abscess forms in connection with diseased spine, it is probably the result of the continued irritation of the tuberculous deposit, and it may become the most prominent and marked feature of the affection, giving rise almost to a distinct and independent disease. The situation and course of these abscesses depend entirely upon the part of the spine affected; thus, for instance, when the cervical vertebræ are diseased, the abscess may come forwards behind the pharynx, and may occasionally extend under the sterno-mastoid muscle to the side of the neck, where it opens; sometimes, though very rarely, it may pass into the chest, and in other cases down into the axilla. When the disease is seated in the dorsal vertebræ, it usually passes forwards under the pillars of the diaphragm down the side of the aorta and the iliac vessels into the iliac fossa, and then presents through the anterior wall above Poupart's ligament. In other cases, again, when the lower dorsal or upper lumbar vertebræ are diseased, the pus gets into the sheath of the psoas muscle, thus constituting the common affection termed "*psoas abscess;*" and passing along this, under Poupart's ligament, presents in the thigh; or it may continue its course downwards, burrowing under the muscles of this region, until it reaches the popliteal space, and even pass from this some distance downwards on to the calf or ankle. I have seen an abscess opened by the side of the tendo achillis, which took its origin in disease of the dorsal vertebræ (fig. 135). In other cases, again, these abscesses take a different course, and, descending into the sub-peritoneal cellular tissue of the pelvis, may present by the side of the rectum in the perineum, or pass out of the sciatic notch, and down by the side of the trochanter. The quantity of pus contained in these collections is sometimes enormous, and abscesses of this description attain a greater magnitude than those of any other part of the body. In other cases the abscess may follow the course of both psoas muscles, and project on either groin, at the same time.

The *diagnosis* of caries of the spine is made at the first sight of a patient affected by the disease, when once the angular deformity has taken place. It is, however, difficult before excurvation occurs, being only indicated at this period by the existence of pain in the back, and by some symptoms of spinal irritation. At this stage it may be mistaken for spinal or intercostal neuralgia, for rheumatism, or for chronic nephritis. The persistence, however, of a continuous fixed pain in the back should always lead to a suspicion as to the true nature of the disease, lest the grievous error be committed of treating as mere neuralgia or rheumatism, what may turn out to be incurable disease of the spine itself. Here the tenderness on pressure, the increased sensibility to the application of heat, with a tendency, though it be very slight, to projection of some of the spines, the feeling of weakness in the back, and especially the occurrence of these symptoms in early childhood or youth, at a period when the other diseases rarely occur, would lead one to suspect the true nature of the affection.

The *diagnosis* of the connection between abscesses in the situations mentioned and those arising from diseased spine, is not always easy, as purulent collections of various kinds may form in the different planes of cellular tissue in the neighborhood of the vertebral column, without any disease existing in it, and these often attain a very considerable bulk before they present externally, which they usually do in the groin. Abscess in the groin may arise from the following causes: 1st, from large lymphatic collections in the subcutaneous or intermuscular planes of cellular tissue; 2d, from disease of the cellular tissue around the kidneys; 3d, from pericœcal abscess (on right side only); 4th, from iliac abscess, whether forming merely in the iliac fascia, or dependent on disease of

the pelvic bones; 5th, from hip-joint disease, the abscess being pelvic; 6th, large buboes or glandular abscesses; 7th, from an empyema perforating the pleura and finding its way down behind the diaphragm. The diagnosis of these various collections may, however, with a little caution, be readily made from the ordinary form of spinal abscess that descends along the psoas muscle. In the first place, in all these cases there is an absence of that dorsal pain and tenderness, with more or less excurvation, which, though not invariably present, is commonly met with in psoas abscess. Then, again, if the collection be perinephritic, there would have been previous, or there are co-existing, symptoms of renal disease. If it occur in the cellular tissue around the cœcum, the pus will be peculiarly offensive, will present itself in a less distinct manner, and will probably be associated with symptoms of intestinal irritation. In those rare cases in which an empyema has found its way between the layers of the abdominal muscles, and presented in the groin, the stethoscopic signs will point out the nature of the affection. In abscess connected with disease of the hip-joint, there will be special evidences of the source of the pus. The only real difficulty consists in diagnosing large psoas abscess presenting in the thigh or in other parts of the lower extremity, and dependent on disease of the vertebral column, from iliac abscess taking its origin in the loose cellular tissue of the iliac fossa, whether it be connected or not with disease of the corresponding bone; and in these cases the difficulty is often not a little increased in consequence of the iliac abscess finding its way into the sheath of the psoas.

In *iliac abscess*, the disease usually commences at or after the middle period of life, always in adults; and, as Mr. Stanley has observed, usually presents itself externally, immediately above Poupart's ligament, being conducted forwards to this situation by the fascia iliaca. Psoas abscess, on the contrary, most commonly occurs in the earlier periods of life; extends down into the thigh along the course of the psoas muscle, so that it always presents below Poupart's ligament. It is also commonly associated with some indication of irritation of the muscle in the sheath of which it is situated; thus, there is an inability to stand upright, to extend the leg, and pain is complained of in walking. Psoas abscess, also, in many cases, occurs suddenly, the patient finding, on washing himself in the morning, that he has got a large soft tumor in the upper part of the groin, whereas iliac abscess comes on more gradually, and presents in a more diffused and less circumscribed manner.

The *prognosis* in caries of the spine is always bad; the deformity always continuing more or less marked; and the patient, though he may eventually recover, by anchylosis taking place, continues hump-backed in after-life. Very commonly the disease terminates in abscess and death. It was long ago remarked by Boyer, that the most fatal cases were generally those in which the spine preserved its straight position; whereas, when it was much curved, death seldom resulted. The truth of this remark I have had frequent occasion to verify; and the circumstance would appear to be owing to the fact, that when the spine continues straight at the same time that the bodies of the vertebræ are tuberculous and carious, anchylosis cannot occur, the spinal canal is opened, and the cord irritated; whereas, when they have fallen together, and very considerable gibbosity has resulted, anchylosis more readily takes place, and thus an imperfect cure is effected.

Treatment. — In infants, the utmost that can be done is to direct that they should be laid prone upon a pillow or small couch constructed for the purpose; that the general health should be attended to by tonics suited to their age; that they should have the advantage of country or sea air; and that some counter-irritant, as the tincture of iodine, should be applied by the side of the spine. In children that are somewhat older, and in adults, great advantage may be derived by strictly forbidding them to walk, stand, or sit erect; confining them rigidly to the prone couch, and adopting a general plan of tonic treatment. At

the same time counter-irritation may be applied with great advantage by means of caustic issues or moxæ to either side of the spine. In fact, the principles of treatment in these cases are extremely simple: the improvement of the general health by good diet, tonics, and sea air, in order to remove the strumous condition with which this disease is always associated, and the employment of counter-irritants suited to the age of the patient, to lessen the local action in the vertebræ, is all that can be done. Rest in the horizontal position is the most important element in the treatment; if the patient be allowed to stand upright or to sit, the weight of the head and shoulders will tend to curve forward the weakened spine, and by their pressure increase the already existing irritation in it. The horizontal position relieves the diseased parts of this additional source of distress. In these cases the prone position is preferable to the supine, and the patient, if old enough, should always be laid upon a properly constructed prone couch, such as was introduced into practice by the late Mr. Verral. This position is certainly the best, for not only is the projecting angle formed by the excurvated spine not injuriously compressed, as it would be in the supine or lateral position, but the patient is more comfortable; and it is far easier to make the necessary application in the way of issues and moxæ than could otherwise be done. At the same time, the back not being the lowest part of the body, there is a less tendency to congestion of the spinal veins, and to consequent increase of the inflammatory softening of the bones. When the disease has in this way been arrested, for which many months—at least twelve or eighteen—will be required, the patient may be allowed to get up and move about, by wearing proper stays so as to support the trunk. It is of considerable importance in the treatment of this disease, that the patient should not be allowed to get or sit up too soon, before the consolidation of the diseased vertebræ has taken place, otherwise he will to a certainty suffer a speedy relapse, or the excurvation will greatly increase.

If debility of the lower limbs or paraplegia should come on, the administration of the bichloride of mercury in doses from the twentieth to the sixteenth of a grain has been strongly recommended by Latham and Stanley. Issues will also be of use in relieving the nervous symptoms, though they may have had little effect on the disease of the bones.

When abscess has formed the surgeon should be in no hurry to open it; but in accordance with the principles laid down when treating of those affections, he should delay doing so, lest injurious fatal constitutional irritation be set up. When it becomes necessary, from the approach of the matter to the surface to give exit to it, this should be done by valvular incision, closed, as soon as the pus has been discharged, by means of hare-lip pins, or in the way described (page 347). The hectic or constitutional irritation that supervenes about this period, must of course be treated on general principles.

Disease of the atlas and axis, and of the atlas and occiput, constitutes one of the most serious forms of vertebral caries. In these cases there is pain, swelling, with great difficulty or absolute inability in moving the head; after a time induration of the cellular tissue, with swelling and fluctuation behind the pharynx come on, pushing forwards its posterior wall against the nasal apertures, causing the tongue to be extruded, occasioning much difficulty and distress in breathing, and giving rise to a peculiar nasal tone in the voice. The abscess may point here, or extend outwardly under the muscles of the neck. Patients affected by this disease truly present a remarkable as well as distressing appearance. The neck being perfectly rigid, they are unable to turn the head, but when they want to look round have to twist the whole body; at the same time, the weakness in the neck usually compels them to support the head with both hands, putting one under the chin, the other under the occiput, and so holding it. The disease often terminates fatally by luxation of the vertebræ forwards, compression of the cord and sudden asphyxia, or more slowly by hectic

and gradual interference with the respiratory functions. The treatment must be conducted on precisely the same principles as that of angular curvature, by absolute rest, counter-irritation and tonics. As great and immediate danger may result from the sudden displacement of the vertebræ, and the consequent compression of the cervical cord, the head usually requires to be steadied by machines calculated to support it and limit its movements.

Disease of the sacro-iliac articulation occasionally occurs. I have had several cases under my care at the University College Hospital, in which the symptoms and post-mortem appearances of the disease were well marked. It commences with pain, tenderness over the junction between the sacrum and the ilium; this is followed by weakness, difficulty in progression, abduction of the limb on the affected side, and some elongation of it from swelling of the affected articulation, and thus a tendency to displacement forwards and downwards of the whole side of the pelvis. After a time abscess forms, which usually acquires a very considerable size, extending under the gluteal muscles, and at last, after many months, or even a year or two have elapsed, pointing by the side of the coccyx or into the rectum. Most frequently this disease terminates in death by hectic, consequent on opening the abscess. Sometimes, but very rarely, anchylosis may take place, and then the limb on the affected side may continue permanently lengthened, for the reason already adverted to. In the treatment the same principles of rest and counter-irritation must be carried out that constitute the basis of the management of all similar affections.

LATERAL CURVATURE OF THE SPINE.

This affection, on account of the frequency of its occurrence, and the tediousness of its cure, has received a good deal of attention from various surgeons, and much has been written upon it by those who have specially devoted themselves to its treatment, but yet, the whole of its pathology and management lie in a very narrow compass.

Fig. 235.

Lateral curvature of the spine most commonly commences at an early period of life, usually between the ages of twelve and eighteen; seldom before the one, and not very commonly after the other; it rarely, if ever, occurs but to females, at least I have never heard of, or seen a marked case of the kind in lads. It appears to consist simply in a relaxation of the ligaments and muscles of the spine, in consequence of which the vertebral column, being no longer able to support the weight of the head, neck, and shoulders, becomes curved to one side, a corresponding deviation taking place in the opposite direction at a lower portion of the spine, in order to preserve the equilibrium between the two sides of the body (fig. 235). The first curve usually takes place in the upper or middle dorsal region, the convexity tending towards the right side; the second, or compensating curve, occurs in the lumbar region, the convexity looking towards the left. In some instances there is a quadruple curve. At the same time that these lateral curves take place, there is always a tendency to rotation of the bones of the spine upon one another, in such a way that the bodies of the vertebræ that form the dorsal curve, are twisted slightly to the left, whilst those that enter into the formation of the

lumbar curve are slightly turned to the right. This twist is sometimes slight, but in such instances it is very marked, so that there is a double curvature, lateral and rotatory. On examining the bones and intervertebral fibro-cartilages after death, even in cases of very considerable distortion, no disease will appear in them, except, perhaps, that the bodies of some may have been slightly com pressed where they form the principal concavity of the arch. The ligaments appear to be stretched, relaxed, and somewhat weakened in these cases; and the muscles are usually pale, flabby, and apparently wanting in power.

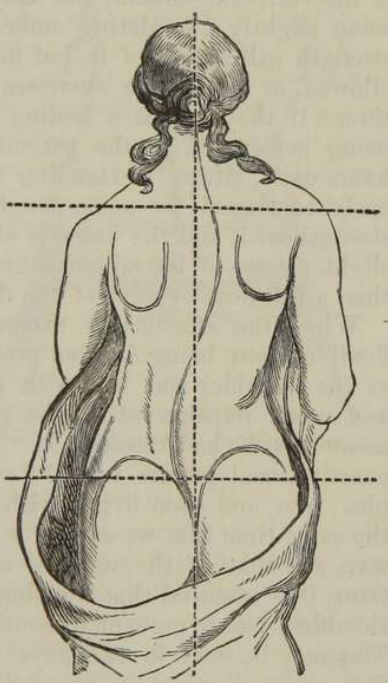
From a consideration of the pathology of this affection, and from the particular age at which it manifests itself, before the bones have become completely ossified, or the ligaments have acquired their due degree of rigidity, its mechanism becomes sufficiently apparent. The spinal column being composed of a number of separate bones, possesses no firmness in itself, or power of self-support, but is maintained in the erect position by the close manner in which its separate elements are knit together by ligamentous and muscular structures, and by the way in which, when thus bound together as a whole, it is supported on either side by the strong mass of the erector spinæ muscles. The proper tension of these ligamentous supports, and muscular masses, is especially necessary for it to maintain the weight of the head and shoulders, which is thrown on the cervical and upper portion of the dorsal spine. If, from any cause, the ligaments become relaxed, and the muscles lose their tension, or if the weight of the upper part of the body increase disproportionately to the augmentation in the strength of the ligaments and muscles that support the spine, the vertebral column will necessarily give way under the pressure to which it is subjected in a direct line from above downwards, and will consequently become curved. Most commonly, indeed almost invariably, this takes place in a lateral direction, the spine yielding more readily in this than in any other. In some rare cases, however, the lower portion of the cervical, or upper dorsal region, will project backwards in an angular manner, and in other cases, of still less frequent occurrence, there may be incurvation of the spine in the lumbar or dorso-lumbar region.

These various kinds of deformity, as has already been stated, chiefly occur in girls about the age of puberty; at a time of life when the tonicity of the muscular system not unfrequently becomes lessened by the occurrence of anemia and those states of impaired health that so frequently attend the establishment of the uterine function; and before the osseous and ligamentous structures of the body have fully developed. At this period of life, also, it frequently happens that the spine becomes rather suddenly elongated by a rapid increase in growth taking place, or that it becomes overweighted by the system developing itself, and the shoulders and bust becoming stout and expanded. Indeed, so frequent is the occurrence of a certain degree of lateral curvature of the spine from these various causes, about the age of puberty in girls, that few escape a tendency to deviation, of so slight a kind, however, as not to admit of recognition as a disease. But if this tendency be allowed to go on unchecked, or if it be increased by injurious habits, amongst which all one-sided postures in which the body is twisted, as in playing some musical instruments, or in leaning over a table in drawing and writing, the slight deviation may rapidly increase until it assumes the true characters of lateral curvature of the spine. I do not think that there is any evidence to show that this is either a strumous or a ricketty affection; indeed, so far as my observation goes, I should certainly say that strumous girls are less liable to the disease than those of a nervous or bilious temperament. A ricketty tendency would, of course, increase the disposition to the affection, but I think it is very rarely associated with it. Amongst the more common predisposing causes must undoubtedly be reckoned the indolent and sedentary occupations, and the luxurious enervating habits that are commonly encouraged in girls in the higher ranks of life, and which,

by preventing due muscular development, at the same time that they induce a general loss of tone in the system, may directly occasion the disease.

The *signs* of this affection, when it is well marked, are distinctly obvious. The serpentine character of the curve, its double nature, the convexity on one side looking to the right shoulder, and on the other, to the left loin, will render its nature evident. Most commonly it commences in a gradual manner, the first condition that frequently attracts attention being the prominence of the right scapula, which is supposed to be "growing out;" or the sterno-clavicular articulation on the same side, or some of the cartilages of the ribs have been observed to project. Whenever the surgeon is consulted for such symptoms as these, he should at once examine the spine, which he will generally find to have an inclination to the right side. In the early stages of the disease, when the deviation is not very distinctly marked, the readiest mode of determining it is to let the patient stand upright, taking care that the feet are well placed together, and that the attitude is not forced, but natural; the surgeon should then run his finger down the back from one spinous process to another, touching each as he passes it with a pen dipped in ink; in this way, when he has reached the lower part, he will have mapped out the course of the vertebral column, and thus may see at a glance the nature and extent of its displacement. At the same time he will probably observe that the two hips do not exactly correspond, the left being somewhat thrown out. Very commonly there is a good deal of neuralgic tenderness about the spine, and at this early stage there may be anemia and symptoms of impaired nutrition. As the disease advances, the curvature becomes more distinct, and at the same time, owing to the torsion of the column, assumes a slightly angular character where most convex. The ribs on the right side are thrown out and bulging, and carry up the scapula with them, whilst those on the left are sunk and depressed (fig. 236). In fact, the whole of the right side of the chest and body partakes in the projection of the spine on that side, and thus adds much to the general deformity; whilst the left side of the chest is correspondingly hollowed and sunk in. When the disease has advanced in this way, it always occasions great general debility, emaciation, and pallor, the nutrition of the body being impaired partly by the compression to which the thoracic and abdominal organs are subjected, and partly, doubtless, by irritation set up in the spinal cord, induced by the curvature.

Fig. 236.



During the early part of the disease the spine preserves its flexibility, and whilst the curve is still recent, and the patient young, if the weight of the head and shoulders be taken off, it will at once resume its straight direction. Thus, if the patient be lifted off the ground by raising her up with the hands under the axillæ, or if she be laid down on her face on a flat couch, the back will fall into a straight position, or may readily be made to do so by slight traction. After the disease, however, has existed for some years, or if the patient has passed that age at which consolidation of the bones and ligaments takes place, the distortion will continue permanently in whatever position she is placed. This is not only owing to the deformity of the spine, but to the ribs, and liga-

mentous and muscular structures generally of the trunk, having become fixed in their abnormal position.

The *treatment* of lateral curvature of the spine should be conducted on rational principles, and when divested of the mystery with which some interested specialists have surrounded it, becomes as simple as that of any other chronic surgical affection of the bones, joints, or muscles. There are three principles of treatment that require to be carried out in the management of these cases. The first is the improvement of the general health; unless this is effected, nothing can be done; the second is to strengthen the muscles of the spine; and the third, to take away as much as possible the weight of the head, neck, and upper extremities. The administration of some of the milder preparations of iron, with a course of aloëtics for the regulation of the uterine function, is of great moment; at the same time a nourishing diet of animal food should be allowed, and the patient encouraged to take exercise in the open air. By these means the nutrition of the system will be improved, and the tone of the muscles greatly restored. The muscular power may be more directly strengthened by having the back well sponged with cold salt or vinegar and water every morning, and methodically rubbed from top to bottom. The friction should be principally directed to the erector spinæ muscles on either side of the vertebral column, and may be done either with the naked hand, or with some slightly stimulating embrocation. At the same time, if the patient's strength will permit of it, but not otherwise, the use of the hand-swing may be allowed, or calisthenic exercises practised; these, however, should not be continued if they induce a feeling of fatigue or exhaustion. Whilst this plan is being persevered in, the patient should be made to lie recumbent for a few hours daily, sitting or standing as little as possible. By these means, assiduously continued for some length of time, the muscles of the back may be strengthened, and the increase of the deformity prevented; and in this way the slighter cases of lateral curvature, those in which there is rather a tendency to, than a full development of the disease, may be cured.

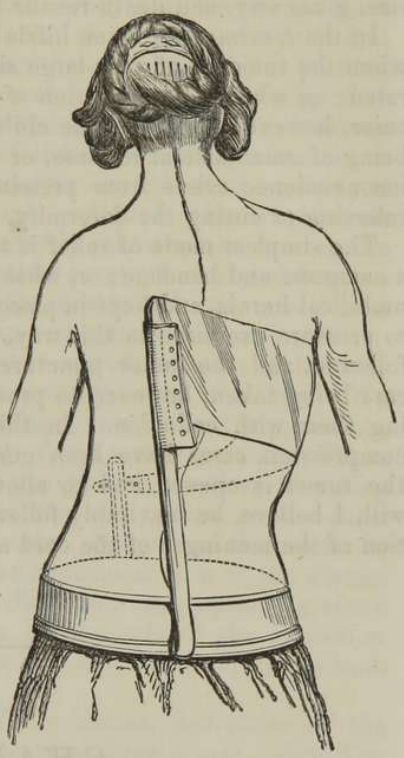
When the affection is further advanced, though the spine still continues flexible, there being decided projection of the ribs on one side, with prominence of the shoulder and hip, with apparent difference in the length of the limbs, and much impairment of the general health, more decided measures of treatment must be had recourse to. In these cases, as in those just described, the constitutional powers must be carefully attended to on ordinary medical principles; iron, and good living, with fresh air, being the basis of the treatment. At the same time that we endeavor to improve the strength of the system in this way, and that of the muscles of the back, specially by cold bathing and frictions, it is essential that we adopt means to take off the weight of the head and shoulders, and to prevent its continuing to keep up, and to increase the deformity. This may be done in two ways: by keeping the patient in the recumbent position, or by allowing her to go about, wearing proper supports.

The recumbent position in the treatment of lateral curvature of the spine, though a valuable means as an adjunct to other measures, has been greatly abused, by being employed as an exclusive plan. This, I think, should not be, except when the patient is unable to stand or walk with comfort, as happens in some of these cases, when it may be necessary to confine her for a time to this position, until the proper muscular power is restored by other means. These instances, however, are very rare; too much so to constitute the rule in the treatment. Whenever the recumbent position is employed, prone seems to me to be far preferable to the supine, for reasons mentioned when speaking of angular curvature of the spine; and the best couch for the purpose is certainly Veral's. The patient should be kept on this during the intervals of exercise, not being allowed to sit or stand, even at meals; she will very soon become accus-

tomed to a position that, at first appears constrained, and will, probably, speedily be enabled to sleep on it.

The best mechanical contrivance for supporting the weight of the head and shoulders, is Tavernier's belt, either in its original form, or as modified and represented in the accompanying wood-cut (fig. 237). By it, the projection of the right shoulder may be gradually brought down, the left one raised, and the weight of the whole of the upper part of the body supported. By this contrivance alone, properly and carefully adjusted to the condition of the deformity, many patients may be treated without the necessity of any confinement whatever; the spine being gradually restored to its proper direction by very gradually increasing the pressure and support of the instrument, at the same time that the general health is carefully attended to, and the patient has the benefit of sea-air. In the majority of cases, however, I think it is well to conjoin the use of this instrument with that of the prone couch; the patient sleeping on the couch, or reclining on it at meals and when in the house, whilst she wears the belt out of doors, and for the purpose of exercise; taking care to apply it and take it off in the recumbent position. In this way many severe cases of spinal curvature may be successfully treated without interfering with the patient's education, or her usual habits. In long-standing cases of deformity of the spine, when its flexibility is lost, and the projection of the ribs has become permanent, the patient will derive great comfort and support from the use of this excellent instrument, and the increase of the disease may thus be prevented, even if direct amelioration be not effected.

Fig. 237.



SPINA BIFIDA.

It occasionally happens from congenital malformation that the spinous processes of some of the vertebræ are deficient, and their laminæ either absent or separated; in consequence of this the meninges of the spinal cord in this situation are unprotected, and project through the aperture in the bones, giving rise to a tumor at the part where the arrest of development in the osseous structures occurs. This tumor is usually of an oval shape, its long axis corresponding to that of the spine. It is generally met with about the size of a walnut or an orange, but occasionally attains an immense bulk, equal to that of a child's head. In some cases this tumor is lobulated, having an imperfect septum stretching across it; in other instances two or more of these tumors have been met with in the spine. The skin covering it is usually of its normal color, but when the tumor is of considerable size it may have a bluish or congested appearance, and admit of a certain degree of transparency. On examining the tumor, which is hard though elastic when the child is held upright, it will be found that it becomes soft when the child is laid horizontally. It usually becomes tense during expiration, and softer during inspiration. In some cases fluctuation is perceptible, and by pressure the bulk may be lessened. Spina bifida may be met with in any part of the vertebral column; it is, however, almost invariably

found in the lumbar region, the cases in which it appears higher up being of very rare occurrence, but instances of the kind are mentioned by Cruveilhier. When it occurs high up in the cervical or upper dorsal spine, it has been found that the spinal cord and nerves are usually adherent to the walls of the tumor; when in the lumbar region this is not the case.

The prognosis of this affection is necessarily unfavorable, the child usually dying, at an early age, of convulsions. In other cases the tumor increases in size, gives way, and death results from spinal meningitis.

In the *treatment* of spina bifida but little can be done in the way of operation when the tumor is of very large size, and the skin covering it inflamed or ulcerated; or when a large portion of the bones appears to be deficient. In those cases, however, in which the child is otherwise healthy and strong, the tumor being of small size at its base, or pediculated, and in which little pain or other inconvenience arises from pressing upon it, some means may be adopted for relieving or curing the deformity.

The simplest mode of relief is to employ pressure on the tumor, by means of a compress and bandage; or, what is better, an air-pad, similar to those used for umbilical hernia, and kept in place by an elastic india-rubber band. In addition to pressure exercised in this way, the recommendation of Sir A. Cooper may be followed, and the tumor punctured with a grooved needle from time to time, care being taken, however, to prevent the ulceration of the punctures by covering them with collodion. In this way, by the combination of puncture and compression, cases have been cured. All other plans of treatment, by which the tumor is opened and air allowed to enter it, are fraught with danger, and will, I believe, be inevitably followed by the death of the child from inflammation of the meninges of the cord and convulsions.

CHAPTER XLVI.

DISEASE OF THE HIP-JOINT.

Hip-disease presents so many points of peculiar and serious importance that it is usually, and not improperly, considered as a distinct affection, apart from other joint-diseases. Like all these it may be of an acute, subacute, or chronic inflammatory character, most commonly occurring in strumous subjects; indeed I think its connection with scrofula is generally more distinctly marked than that of most other affections of the joints. It almost invariably occurs before the age of puberty. Out of 48 cases of this disease, of which I have taken notes, I find that in 16 only did it take place at or after fifteen years of age, and of these, in 6 cases only did it happen above the age of twenty; thus it may be considered essentially a disease of childhood or early youth. It commonly comes on from very slight causes; over-exertion in a long walk, a sprain in jumping, a fall, or sitting in the wet, are usually the circumstances to which its occurrence is attributed.

All the inflammatory affections attacking the coxo-femoral articulation are usually confounded under the term "Hip Disease" or "Coxalgia." This is too general an expression; and we shall find included under it several distinct forms of disease that differ from one another in pathology, symptoms, result, and treatment. On looking at the hip-joint in a surgical point of view we find it to be composed of three distinct parts; viz., the soft structures, the acetabulum, and the head of the femur. Any one of these may be principally or primarily

affected, and we may accordingly divide hip-joint disease into the three distinct forms of *arthritic*, *acetabular*, and *femoral*.

This division is not a purely pathological one, but is of a practical character, especially in its bearing on the question of excision.

Before proceeding to describe each separate form of coxalgia, we may consider briefly the four pathological conditions which are more or less common to each variety of the affection; viz., *pain*, *suppuration*, *dislocation*, and *anchylosis*.

1st. *Pain*.—The pain in hip-joint disease varies greatly according to the form the affection assumes. In the more chronic forms of the disease it is at first slight, and, perhaps, rather referable to the knee than the hip; this is particularly the case in the *femoral* variety. In the *arthritic* form it is always very acute, seated in the joint itself and greatly increased by any movement, however slight, of the limb. In the *acetabular* form of the disease the pain is not at first referred to the joint but rather to the iliac fossa or side of the pelvis; it afterwards becomes severe, gnawing, and deeply seated in the articulation. However slight the pain may be, it is always greatly increased on moving the limb, on pressing the surfaces of the articulation together, or by abduction. Hence the usual position of the patient with the foot raised and merely supported on the point of the toes, the knee and hip being flexed and adducted.

2d. *Suppuration* is not a necessary consequence of inflammation of the hip-joint, though in strumous subjects it more commonly occurs than not. We often see the *arthritic* variety of the disease run its course without suppuration, but in the *acetabular* and *femoral*, abscess always forms sooner or later. These abscesses usually form behind the joint, under the gluteal muscles; they may open in this situation or burrow under the fascia lata, and present on the outer aspect of the thigh below the tensor vaginæ femoris. Sometimes they occur in front of the joint under the pectineus, and in the acetabular form of the disease they are commonly intra-pelvic, forming in the iliac fossa, and presenting above or under Poupart's ligament, or passing down by the side of the rectum or through the sciatic notch, and thus finding their way downwards upon the back of the thigh.

3d. *Dislocation*.—In the advanced forms of hip-disease, dislocation of the head of the femur commonly occurs and may arise from three causes:—1st. The destruction of the joint, the capsular ligament having given way in consequence of inflammatory softening and ulceration, and the head of the bone being thrown out of the cavity by the action of the surrounding muscles. 2d. Caries and partial absorption of the head of the femur may have taken place, so that it no longer fills up the cotyloid cavity, and the ligaments being at the same time destroyed, it slips out on to the dorsum ilii. 3d. A fungous fibro-plastic mass may sprout up from the bottom of the cavity and thus tend to push the bone out of it, and after it has been so extruded, this growth will completely fill the acetabulum.

The occurrence of dislocation is, in the great majority of cases, preceded by the formation of abscess in and around the joint; but in some instances it happens in consequence apparently of the softening of the ligaments, the head of the bone being thrown out of the acetabulum, without the supervention of abscess or any sign of suppuration. In these cases a false joint may be formed upon the dorsum ilii, where the head of the bone lodges. When it is lying in a suppurating cavity it will always be found to be in a carious state, and then no attempt, or at least an imperfect one, is made at the construction of an articulation around it.

Dislocation takes place chiefly in the *femoral* variety of the disease, in which the head of the femur is more or less destroyed, and the acetabulum filled with fibro-plastic deposit. In the *acetabular* form, the head of the bone is not thrown out of the cavity, which is carious, and which becoming at last perforated, may allow the upper end of the femur to slip into the pelvic cavity.

4th. *Anchylosis* may occur either with or without previous suppuration. If the joint has suppurated and the head of the bone is thrown on the dorsum ilii, a false joint may eventually form, or osseous anchylosis in a more or less faulty position take place. If the head of the bone continue in the acetabulum without suppuration, osseous anchylosis (fig. 221) may ensue with but little shortening of the limb.

The Arthritic form of hip-joint disease may commence in any of the soft structures of the joint, in the capsule, the synovial membrane, the cartilages, or the ligamentum teres. Mr. Aston Key believed that the ligamentum teres was very frequently the starting-point of inflammation of the hip-joint, and other surgeons have referred its origin to each of the other structures mentioned. Without denying the possibility of disease sometimes commencing in the ligaments, illustrative of which we have a beautiful model in the Museum of University College, I believe that it more frequently commences in the cartilage incrusting the head of the femur, for though it is extremely difficult to prove this, opportunities of dissecting this form of hip-disease in its early stages being very rare, yet the symptoms that attend it so closely resemble those accompanying the diseases of this structure in other joints, that it is difficult not to infer that this may be the case in the hip.

In this form of the disease the patient is seized with signs of acute inflammation of the joint, coming on pretty rapidly, and with great constitutional disturbance and pyrexia. The pain in the joint in these cases is of the most excruciating character, accompanied by spasms and twitchings of the limb, and marked by nocturnal exacerbations. The suffering is so intense, that the patient cannot bear the slightest movement of the limb; a fit of coughing, the weight of the bed-clothes, or the shaking of the bed by a person leaning against it, will give rise to the most intense agony; and in the intervals of his suffering the patient is in constant fear of a return of the pain, to which he looks forward with much anxiety. In these cases the limb is everted, abducted, perfectly helpless, and motionless; the nates will be found flattened, and there is usually some fulness about the anterior part of the joint, under the pectineus muscle, or to its outer side, above the trochanter. There is also sometimes true elongation of it in consequence of the capsule becoming distended with fluid, and pushing the head of the bone downwards. On measuring the limb, in order to ascertain its true length, it is necessary to examine the two together, and to place the sound in exactly the same position as the diseased one; unless this be done, error will very probably creep in, for on measuring the lower extremity, from the anterior superior spine to the lower border of the patella or the inner malleolus, it will be found to be of greater length when adducted or extended than when abducted or bent.

In some cases the distension of the capsule with synovial fluid, as the result of the inflammation in the joint, may be so great as to lead to its rupture, and to the sudden dislocation of the head of the bone on to the dorsum ilii, with great pain and much shortening; this, however, is of very rare occurrence, the dislocation seldom taking place until after abscess has formed within the joint, and the articulation has been thus destroyed. In this, the acute form of hip-disease, various terminations may take place; the result depending greatly upon the constitution of the patient, and the manner in which the affection is treated. Under the most favorable circumstances, as the inflammatory action is subdued, the disease falls into the subacute condition, and recovery gradually but very slowly takes place, with a limb that continues somewhat stiff and partially anchylosed, as well as wasted and somewhat shortened from disuse. Sometimes, complete anchylosis occurs without the previous formation of abscess. In other, and the majority of instances, abscess forms, and then the patient may either be worn out by the continued irritation of diseased bone, or by the profuseness of the discharge; or great shortening taking place either by the

absorption of the head of the bone, or its dislocation out of the acetabulum, the cavity of the abscess may ultimately contract, the carious portions of bone exfoliate, and the sinuses close after years of suffering. Under the most favorable circumstances, when once the joint has been acutely inflamed, a year or two will elapse before the patient can use his limb with any degree of security. The safety of the patient depends in a great measure on preventing the occurrence of suppuration. If the constitution be of a very strumous character this can rarely be done, but if tolerably healthy, the disease may be prevented passing on to this stage, and then the patient may recover with a useful, though somewhat stiff and crippled limb. If suppuration occur, it is very seldom that an adult patient recovers, hectic and exhaustion speedily carrying him off. The life of children may, however, be saved even under these circumstances; but they will be left permanently lamed.

In the *acetabular* form of the disease, the first serious symptom is often abscess in the iliac fossa, with pain around the hip rather than in the joint itself. This however becomes tender on pressure, the patient cannot bear on the limb, but no alteration in its length takes place, although it becomes greatly wasted. The abscess which was at first intra-pelvic soon passes down under Poupart's ligament, or finds its way by the side of the rectum, or through the sciatic notch into the gluteal region. Hectic comes on, the sufferings become greatly increased, and death from exhaustion speedily ensues in this, which I believe to be the most fatal form of hip-disease.

In the *femoral* form of coxalgia, the disease usually commences in a very insidious manner. It assumes a subacute character, and is chiefly met with in young children. The first symptom that usually attracts attention is that the child limps and walks in a peculiar shuffling, hopping manner; he does not stand firmly upon both feet, but rests on the toes of the affected one, the knee of which is bent. On examining the condition of the limb it will be seen to be everted, somewhat abducted, slightly flexed upon the thigh, with the knee partly bent, and apparently shorter than the other. This shortening, however, is apparent and not real; for on laying the child on its back, it will be found that the pelvis is placed obliquely; the anterior superior spine on the affected side being raised to a higher level than that on the sound one, and at the same time turned somewhat forwards; measurement of the limb from this point to the ankle, will show that there is no alteration in its length. The obliquity of the pelvis, which is of very early occurrence in diseased hip, is owing to the child lifting the foot off the ground in order to avoid pressing on it in walking or running, and in doing this he is obliged to raise, not only the limb, but the corresponding side of the pelvis. This apparent shortening will commonly give place, after keeping the child in bed for a few days, to a simulated elongation of the limb; the pelvis on the affected side descending below its natural level. At the same time that these symptoms are noticed, the child usually complains of pain in the hip, especially on pressing over the pectineus muscle, or behind the trochanter; this is increased by standing, walking, or any attempt to bear upon the joint; abduction also, and rotation of the limb outwards, is particularly painful, and any concussion of it, as by striking the heel or knee, will greatly increase the suffering. At this stage of the disease, the patient will often refer to the knee rather than the hip as the seat of pain, and a careless surgeon might be misled and treat the wrong joint; the more so as there is not unfrequently a good deal of cutaneous sensibility about the inner side of the knee-joint. This pain appears to be seated in the obturator nerve, the articular branch of which sent to the hip-joint becoming implicated in the disease, communicates a radiating pain that is felt at the extremity of the long descending branch which is distributed to the knee. On turning the child upon its face it will be observed that the nates are somewhat flattened, the fold being in a great

measure obliterated, and, if it be a female, the vulva on the affected side will be seen to be placed at a lower level than on the sound one.

As the disease advances, abscesses may form at any part in the vicinity of the joint. They most commonly occur under the glutei muscles, but sometimes at the anterior part, under the pectineus muscle. When in this situation, they occasionally give rise to very severe suffering down the inner side of the thigh by exercising pressure upon the obturator nerve, which may sometimes become tightly stretched over the subjacent cyst of the abscess. It is about this period that true shortening of the limb takes place, which at the same time becomes adducted and inverted, thus assuming a very different position to what it presented in the early stage of the disease. The different positions into which the limb falls in the two stages of the complaint are evidently due to alterations in the muscular action brought to bear upon it. In the early stage, these strong external rotators, which are in close relation with the joint, become irritated by the extension of inflammatory action to them, or by the pressure to which they are exposed by the distended capsule; and hence, being called into increased action, the limb is everted, at the same time that it is slightly flexed and adducted by the irritation to which the psoas and iliacus are subjected. As the disease advances, these muscles become wasted, undergo fatty degeneration, absorption, or disintegration, by the formation of abscesses underneath and around them; hence, the action of the adductor muscles being no longer counterbalanced, the limb is drawn upwards and forwards, and turned inwards (fig. 238).

The shortening of the limb may arise, in very chronic cases, from general atrophy of the member, consequent upon disuse; and this, no doubt, in all instances, after a time, influences its condition. Most commonly, however, it occurs from absorption of the head of the bone, and in other cases from its dislocation upon the dorsum of the ilium. In these cases, the remains of the dislocated head can be felt through the thin and weakened muscles in its new situation, and in other instances may be felt lying at the bottom of a cavity in a carious state (fig. 239).

Fig. 238.

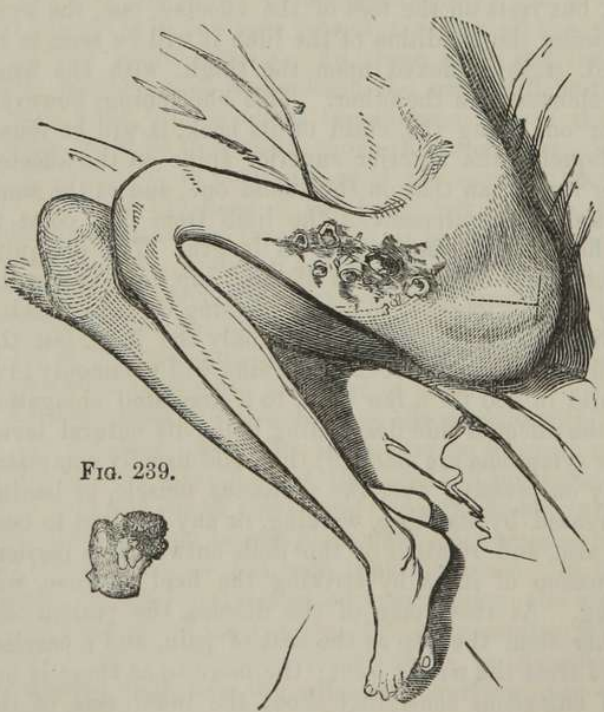


Fig. 239.

After the formation of abscesses, the health, which may up to this time have kept pretty good, speedily gives way, exhaustion and hectic coming on, and the patient, perhaps, at last sinking from the wasting influence of the diseased bone, and the discharges it occasions.

In making the *diagnosis* of coxalgia, care must be taken not to confound it in its early stages with an ordinary attack of rheumatism; a mistake that not unfrequently happens; the alteration in the shape and position of the limb, the obliteration of the fold of the nates, and the limitation of the pain to the one joint, will usually prevent the surgeon falling into this error. With disease of

the knee care must be taken not to confound hip disease, in consequence of the pain in the early stages being commonly referred to that joint; here the absence of any positive sign of disease about the knee, and the existence of all the signs of disease in the hip that have already been noticed, will enable the surgeon to diagnose the true seat of the affection. Lateral curvature of the spine, accompanied by neuralgic tenderness in the hip, occasionally gives rise to apparent shortening of the limb with pain and rigidity; but in these cases the existence of the spinal affection, the superficial nature of the pain, and the absence of increase of suffering when the joint is firmly compressed, or of painful startings at night, will indicate the true nature of the affection. Abscess may occasionally, though rarely, form in the vicinity of the hip without that joint being diseased. Should this take place towards the anterior aspect of the articulation under the pectineus muscle, it may, by its pressure upon the obturator nerve, occasion pain in the thigh and knee, as in those cases in which the articulation is affected; here, however, the sound state of the joint at its posterior and outer part, the absence of all obliquity of the pelvis, and of the other signs of the true hip-disease, will enable the diagnosis to be effected.

The *treatment* of disease of the hip must be conducted with reference to the form of the disease, the acuteness of the attack, and the severity of the local and constitutional symptoms. In all cases this affection must be managed in accordance with those general principles that guide us in the treatment of inflamed joints.

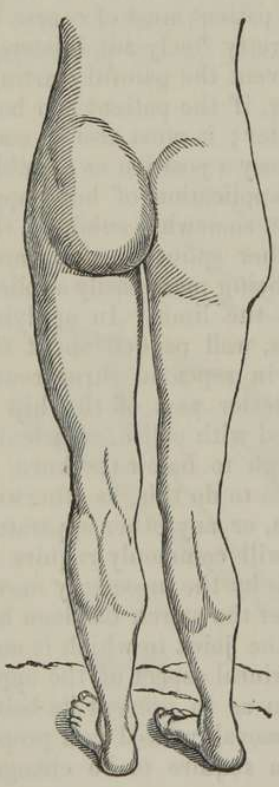
When the disease is of the acute *arthritic* kind, the patient must of course be kept in bed, and be treated with calomel and opium, pretty freely administered, having a full dose of opiate at night, in order to prevent the painful startings of the limb. The inflamed joint should be leeched, or, if the patient can bear it, cupping-glasses may be applied behind the trochanter; it must also be comfortably arranged upon pillows, so as to be kept in as easy a position as possible, and great relief will be afforded to the patient by the application of hot poppy fomentations. When the inflammatory action has been somewhat subdued, the joint may be conveniently fixed by means of a leather splint or the starch bandage. Of the two, I prefer the starch bandage, as being more easily applied, and forming a better fitting and more secure casing to the limb. In applying it, the limb should be bandaged from the toes upwards, well padded about the knee with cotton wadding, and the bandage carried in repeated turns round the hip and body in the form of a spica; at the posterior part of the hip it should be strengthened with a piece of pasteboard lined with calico, sufficiently long to extend down the whole of the back of the thigh to below the knee, so as to support that joint also. It is of much importance to do this, as otherwise the hip cannot be kept immovable. In applying this, or any other apparatus, in the more acute form of the disease, the patient will commonly require to have chloroform administered, as the pain occasioned by the necessary movements would otherwise be too severe to be borne. After the starch bandage has well set, a trap may be cut in it opposite any part of the joint to which it may be thought necessary to make applications, and the perineal aspect of the apparatus must be well lined and covered with oiled-silk, so as to prevent its being injuriously soiled. In this way the limb may be immovably fixed in a proper position by a light and firm apparatus that will seldom require to be changed during the treatment of the case.

When the disease has fallen into a somewhat chronic condition, or from the very first of the subacute or *femoral* variety, a different and less active line of treatment requires to be pursued. In these cases, rest and perfect immobility by means of the starch bandage are indispensable; in conjunction with this, the employment of counter-irritants, more particularly the caustic issue, will be attended with great advantage; the issues may readily be applied through traps, cut in the apparatus behind the trochanter, and at the forepart of the

joint opposite the pectineus muscle. At the same time a course of moderate alteratives and tonics conjoined, will be found most advantageous. To children, a powder composed of a grain of mercury and chalk, two grains of carbonate of soda, and three of rhubarb, with or without half a grain of quinine, may be administered twice a day. To adults, the bichloride of mercury in small doses with sarsaparilla or bark will be found most useful. This alterative plan must be persevered in for a sufficient length of time, and as the symptoms of inflammatory action subside, and those of strumous disease manifest themselves more unequivocally, cod-liver oil, with the iodides of potass or of iron, may be advantageously substituted.

During the whole of the treatment, the general health requires careful supervision, the diet must be attended to, and should be as nutritious as possible, the state of the bowels regulated, the skin kept in good action with a flesh-brush, and the patient reside in well-ventilated apartments. It will very generally be found that the liver is peculiarly apt to get out of order in this disease, the patient becoming jaundiced and feverish; these complications must be treated on general principles. As the health improves, a change to the sea-side will be attended with great advantage, and the patient may be allowed to move about on crutches, having the foot suspended in a sling, as in the case of a fractured thigh. Under such circumstances the best result that can usually be looked for is a stiff joint (fig. 240); but even if this forms, the patient's condition will be far from unfavorable, for the want of movement in the hip becomes counter-balanced by the greatly increased mobility of the lumbar vertebræ, enabling the patient freely to rotate the pelvis.

Fig. 240.



As abscesses form they should be opened early; no good resulting by delaying to give exit to the pus, which only spreads more widely, disorganizing the soft structures, and means should be taken, by tonic remedies and nourishing food, to keep off hectic. If dislocation has taken place, and the limb consequently becomes a good deal shortened or deformed, being perhaps adducted and inverted so far as to be twisted over the other, or drawn up upon the abdomen, much may be done to lessen the deformity by putting the patient under chloroform, bringing down the limb, and fixing it in a starch bandage. Anchylosis may thus be sometimes got in a good position, and the patient's condition be greatly improved. It is a question whether an attempt at reduction should be made in these cases of consecutive dislocation, as it is very rarely that it would prove permanently successful, the acetabulum being either filled up with fibrous matter, or the head of the bone so diseased and lessened in size, that it would not remain in its cavity when put back. Occasionally, however, the reduction may be successfully effected. In a woman, under my care, at the hospital, with spontaneous dislocation of the hip of about a month's duration, reduction was effected by means of the pulleys, and the head of the bone replaced in the cotyloid cavity, where it remained for some weeks; becoming, however, displaced again in consequence of its being necessary to remove a bandage that was applied, as she became affected with inflammation of the chest, and could not bear its pressure. If anchylosis is likely to occur, the surgeon must endeavor to secure it with the limb in a straight posi-

tion. After a stiff joint has formed, the mobility of the lumbar vertebræ will be found to be greatly increased, so that at last the patient will walk with little inconvenience, rotating the pelvis on them. If the anchylosis be not osseous, and especially if the head of the bone be still in the acetabulum, the limb may be straightened by forcible extension under chloroform, and the heel thus brought to the ground.

The *excision of the head of the femur*, in some forms of hip-disease, has of late years been much discussed. This subject has more especially had attention directed to it by the writings of Fergusson, H. Walton, and H. Smith. "But even yet," says Mr. Fergusson, who is one of its greatest advocates, "experience as to the results of this operation is so limited, that I can scarcely say more on the subject than express a belief, that in some instances of disease, and of gun-shot injury of the neck or head of the bone, such a proceeding might be of service." The cases requiring it are necessarily not very numerous. It may, however, be stated, that when the disease is of the *femoral* kind, being limited to the head and upper end of the femur, the acetabulum and pelvic bones not being involved, but the head of the bone displaced from its cavity, and lying in a carious or necrosed condition on the dorsum of the ilium, with sinuses leading down to it, the patient's general health reduced by hectic, consequent upon the profuseness of the discharge and the irritation of the disease, the surgeon would certainly be justified in cutting down upon, and removing the source of all this mischief, with a view of preserving the patient's life, in accordance with those general principles that guide us in the management of diseased bone in other situations. The cases, however, in which this peculiar combination of circumstances occurs, and in which such an operation would consequently be required, are rarely met with. The great objection to the operation, in the majority of instances, being the extension of disease to the cotyloid cavity and the bones of the pelvis, involving them to a considerable extent, and in such a way as to prevent the complete removal of the diseased osseous structures. Even if the patient's life be not endangered, the removal of the carious bone may be rendered necessary in order to obtain sound anchylosis between the upper part of the femur and the pelvis, and thus to secure a useful limb to the patient.

In hip-disease the acetabulum will be found to possess far greater reparative powers than the head of the femur, so that even when diseased it may recover itself; its disease, when moderate, is therefore no absolute bar to the performance of excision of the head of the femur.

In many cases examination with a probe will enable the surgeon to detect the existence of disease in the bones of the pelvis, as well as in the head of the femur; but in other instances it may not be possible for him to do so, the probe not being able to reach the carious bone, owing to the quantity of dense plastic matter that is thrown out around it. Under these circumstances, the question as to the propriety of performing the operation may, to a certain extent, be determined by the position of the head of the femur. If this has been dislocated early in the disease, and be lying in a carious condition upon the dorsum ilii, the probability is that the morbid action is confined to it, the acetabulum being filled up with fungoid plastic matter. If, however, the displacement has been of recent occurrence, it is not unlikely that the osseous surface of the cotyloid cavity is involved. If the head of the bone still continue in its socket, the operation should not, generally, be undertaken; for in these cases, if the disease is far advanced, the morbid action will almost invariably have extended to the bottom or sides of the acetabulum. But even in such a case as this, those excellent surgeons, Mr. Jones of Jersey, to whom modern conservative surgery is so deeply indebted, and Mr. Hancock, have successfully removed not only the head of the femur but a large portion of the diseased acetabulum.

The operation itself is not difficult of performance, the carious head of the

femur, lying at the bottom of an abscess or of sinuses, may readily be exposed by a T shaped incision over it (fig. 241). When it is exposed it may be turned out by drawing the limb over the opposite thigh, rotating it inwards and pushing it upwards, when it may be cut off through the neck or trochanter by means of an ordinary saw, or what is better, by passing the blade of Butcher's saw behind and cutting forwards. In planning the incisions, care must of course be taken not to cut too far forwards, lest the anterior crural nerve be wounded; or too freely backwards, lest a gluteal artery be injured. After the operation the wound must be dressed in a simple manner, and a long splint applied. Mr. Fergusson recommends that the extension should be made from the opposite thigh, round the upper part of which a laced socket is fixed, to which the band is attached (fig. 242). In such cases as these, much advantage will be derived by the use of the bracket thigh-splint. Shortening of the limb will necessarily result, but

Fig. 241.

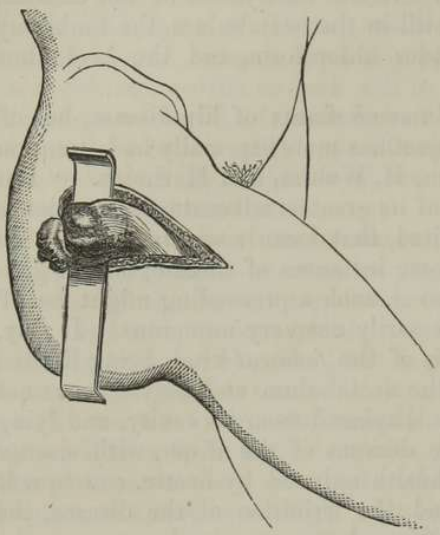
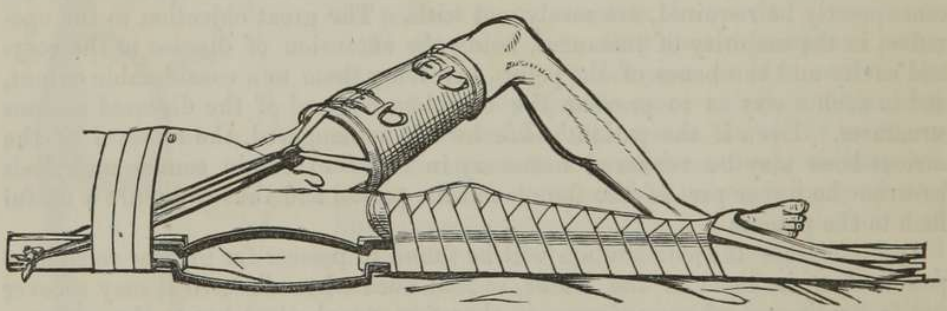


Fig. 242.



as this has already occurred, being the inevitable consequence of all disease of the hip that gives rise to the dislocation of the bone, it need scarcely be taken into account; the operation being rather done with the view of saving the patient's life in the only way that is practicable, than to improve the length of the limb.

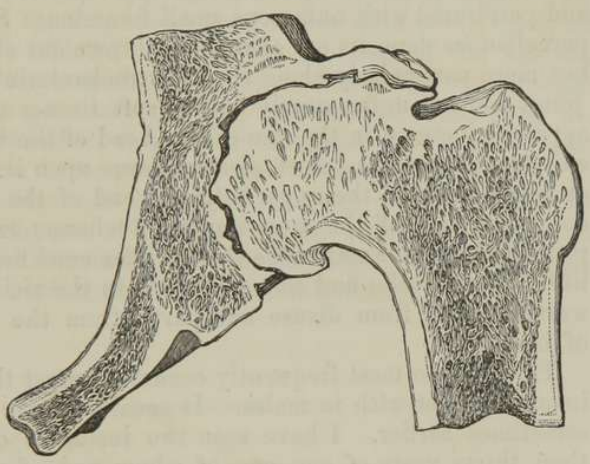
The result of excision of the hip-joint depends on the extent of osseous disease. When the head of the bone is solely the seat of caries, lying dislocated on the dorsum ilii, the operation may be done with a fair prospect of success. When the acetabulum is but slightly implicated, a portion of its lip being possibly diseased, the gouge may be successfully applied to this, and the result of the operation will not be materially changed. But if the pelvic bones be primarily or chiefly affected, and more particularly if the head of the femur be still lying on the cotyloid cavity, with perhaps perforation of the bottom of this and intra-pelvic abscess, little good can be expected or result from an operation for the proper performance of which it would be necessary to remove the greater part if not the whole of the acetabulum, and thus open up the cavity of the pelvis. But that such a desperate operation as this even may be performed with a successful result, is proved by the interesting cases to which reference has just been made; and as the "acetabular" form of hip-disease is necessarily fatal if left to itself, these cases may encourage surgeons in attempting to save the

patient by the only alternative open to them. The statistics of the operation are not very perfect, but as far as I can ascertain it has been performed 38 times, with 14 deaths as its direct result.

CHRONIC RHEUMATIC ARTHRITIS.

A peculiar disease has of late years been described by Mr. Adams and Mr. R. W. Smith, to which the name of "chronic rheumatic arthritis" has been given. It commonly affects the hip, but has been met with in the temporo-maxillary articulation, and also occurs in the shoulder; at least I have met with cases of disease of this joint presenting all the characters of this affection during life, though as there has been no opportunity of examining the state of the parts after death, it is impossible to speak positively as to the true nature of the disease. Chronic rheumatic arthritis is an active disease of the bones and fibrous expansions about the joint, being especially characterized by considerable increase in the size and by alteration in the shape of the osseous structures, which become porous in some parts, porcellanous in others, with thickening of the fibrous capsule of the joint, deposit of masses or plates of bone in it, and ultimate destruction of the cartilages and synovial membranes. The suffering attending the disease is considerable, it greatly cripples the utility of the joint, at last produces incomplete anchylosis of it, and is incurable.

Fig. 243.



CHRONIC RHEUMATIC ARTHRITIS OF THE HIP.

This form of the disease commences with a degree of pain and stiffness about the joint, increased at night, and especially in damp or cold weather, presenting in this respect the ordinary characters of a rheumatic affection; as the disease advances, the pain is much increased by standing or walking, and the movements of the joint become gradually more and more impaired. The patient experiences the greatest difficulty in bending the body forwards from the hips; he consequently is unable to stoop, or to sit in the ordinary position, being obliged to keep the limb straightened in nearly a direct line with the trunk. The difficulty in walking, in standing erect, in stooping, and in sitting increase. The limb becomes shortened to the extent of about an inch or more, owing to changes that take place in the head of the bone. The pelvis also assumes an oblique direction, and hence the apparent shortening becomes considerably greater. The knee and foot are everted, and the heel raised. The shape of the hip also alters considerably; it becomes flattened posteriorly, the folds of the nates disappear, but the trochanter seems to project, and on examination seems larger and thicker than natural. On rotating the limb it will be felt that the movements of the bone are extremely limited, and crackling or osseous crepitation will often be felt around the joint. As Mr. Smith remarks, the lumbar vertebræ acquire great mobility, the thigh on the affected side is wasted, but the calf retains its natural size and firmness.

On examination after death, it will be found that the joint, the bones, and the surrounding parts have undergone remarkable changes. The capsular ligament is thickened, and the synovial membrane is of a bright red color, vascular, and fringed in some parts, whilst it has disappeared in others. The ligamentum teres is destroyed, and the head of the bone denuded of membrane, the vascular fringes being attached around the neck. The head of the bone becomes remarkably altered in shape, being flattened, greatly increased in size, or placed more or less at a right angle with the shaft, sometimes elongated, and always very irregular and tuberous. The neck is more or less absorbed, and in some cases appears as if it had undergone fracture. The acetabulum generally becomes enlarged, sometimes of a more or less circular and flattened shape; at others, projecting at its rim, narrowed, and embracing tightly the head of the femur (fig. 236). Both it and the upper part of the thigh-bone become porous, and perforated with numerous small foramina. Stalactitical masses of bone and porcellanous deposits are commonly thrown out about the base of the trochanter, but more particularly along the intertrochanteric line within the capsule of the joint, and not unfrequently in the soft tissues around it. In many cases the apparent increase in the size of the head of the bone is dependent on the depositions of these masses of osseous tissue upon it, rather than on any expansion or osteoporosis of the upper articular end of the femur. These masses of bone constitute one of the most important characters of the disease, and it is their presence that communicates the peculiar crackling that is felt in the hip during life. The muscles and soft structures in the vicinity of the joint are necessarily wasted, partly from disuse and partly from the pressure of the morbid masses of bone.

This disease most frequently occurs amongst the poorer classes, and is almost invariably met with in males. It usually occurs about the age of fifty, though sometimes earlier. I have seen two instances of it in individuals little more than thirty years of age, one of whom was a female. It is an incurable affection, and, as it is commonly attended by much suffering, constitutes a source of great discomfort to the patient.

It occasionally happens that individuals laboring under this affection, meeting with a fall or contusion on the hip, present many of the signs of fracture of the neck of the thigh-bone, such as shortening, eversion, with some crepitation perhaps, and inability to move the limb. The diagnosis may in general readily be effected by attention to the history of the case, and by eliciting the fact that the symptoms have existed to some degree before the accident, although the pain and immobility may have been increased by it.

In the *treatment* of this affection little can be done. Rest and the habitual application of warm or stimulating plasters will afford relief, and, in many instances, the administration of the iodide of potass with sarsaparilla will lessen the nocturnal pain. Mr. Smith recommends an electuary composed of guaiacum, sulphur, the bitartrate and carbonate of potass, and ginger, with a small quantity of rhubarb, and I have certainly seen benefit result from the administration of this remedy in some cases. When the disease is once fairly established, and has assumed a very chronic character, nothing can be done except to mitigate the pain by some such means as those recommended, conjoined with rest and careful attention to the general health.

Chronic rheumatic arthritis has also been described by Mr. Smith as occasionally affecting the temporo-maxillary articulation in individuals of rather advanced life. This disease is mostly symmetrical, and gives rise to an enlargement of the condyle of the jaw, which can be felt under the zygoma, attended with much pain in opening the mouth, a sensation of cracking or grating in the joint, and some enlargement of the lymphatic glands by the side of the neck. The pain is generally increased at night, and influenced by the state of the weather. The face becomes distorted, the affected side of the jaw projecting

and being pushed towards the opposite side, but when both joints are affected the chin projects, the entire jaw being drawn forwards. This distortion is chiefly owing to the destruction of the articular eminence; for when this takes place, the external pterygoid muscle draws the jaw forwards and to the opposite side; but when both articulations are equally affected, these muscles displace it directly forwards; the glenoid cavity becomes enlarged, the fibro-cartilage disappears, and the condyle is sometimes greatly thickened and flattened, and always rough, being devoid of cartilage. In such cases as these there is little to be done by medicine, but the treatment must be conducted on the same principles as in the same affection when attacking the hip.

When affecting the shoulder, chronic rheumatic arthritis gives rise to considerable enlargement of the head of the humerus, wasting and rigidity of the deltoid, and inability to move the elbows upwards, except by the rotation of the scapula on the trunk. In fact, the scapulo-humeral articulation being fixed, all movements of the shoulder are effected through the medium of the scapula, which becomes more mobile than natural. The articulation is the seat of much pain, lancinating at times, but generally gnawing and intermittent, being dependent on the state of the weather, and greatly increased in cold and wet seasons. The whole of the arm becomes wasted and weakened in power. In two instances I have seen this disease in young and otherwise robust and healthy men, between twenty and thirty years of age, coming on without any apparent cause. In both cases the joint continued permanently rigid, though the pain was relieved by the use of the iodides and local counter-irritation.

CHAPTER XLVII.

DISEASES OF THE APPENDAGES OF THE JOINTS.

DISEASES OF THE BURSÆ.

The bursæ which naturally exist, either under the skin, beneath the muscles and ligaments, or around tendons, are subject to various diseases. Not only do the normal bursæ become affected, but these sacs are sometimes developed from continued friction in situations where they are not naturally met with, and here also they may undergo disease; thus, for instance, bursæ have been found to be formed at the projecting point of a hump-back, on the prominent parts of club-feet, or at the extremity of stumps.

In the following situations bursæ naturally occur, and may consequently be expected to be met with in a diseased state. Behind the angle of the lower jaw, on the symphysis of the chin, on the angle of the thyroid cartilage, on the acromion, external and internal condyles of the humerus, olecranon, styloid processes of the ulna and radius; on the dorsal surface of the metacarpo-phalangeal articulations, as well as on their palmar surfaces, and on the dorsal aspect of the phalangeal articulations; on the anterior superior spine of the ilium, the great trochanter, the tuberosity of the ischium, the lower superior and outer parts of the patella, on each condyle of the femur, the tuberosity of the tibia, the two malleoli, the calcaneum, the dorsal aspect of the toes, and on the plantar aspect of the heads of the first and fifth metatarsal bones. Besides these situations they occur under the deltoid, the gluteus maximus, between the lower end of the scapula and the latissimus dorsi, and in the ham.

The continued irritation of bursæ by the pressure that is exercised upon them, may cause them to inflame, to enlarge, to become thickened, or to undergo various changes in structure. This enlargement of the bursæ in particular situations is often connected with special employments, by which continuous and severe pressure is exercised upon certain parts of the body; thus frequent kneeling will occasion enlargement of the bursa patellæ, hence called "housemaid's knee." Miners are occasionally subject to an enlargement of the bursa lying over the olecranon, hence called "miner's elbow," and in any situation a new bursa may be formed by continuous pressure and friction conjoined.

The contents of enlarged bursæ vary greatly; they may be composed simply of a serous fluid of a clear straw color; at other times this becomes dark and brownish, with much cholesterine intermixed, and may contain a number of whitish bodies, of a fibrinous or cartilaginous appearance, about the size of grains of rice and not unlike them. On examination under the microscope, I have found these granular bodies composed of a fibro-plastic material, in some cases resembling imperfectly-developed granulation cells; they would therefore appear to consist, as Sir B. Brodie long ago pointed out, of masses of lymph that have either been deposited in the shape in which they are found, or that have been divided and broken down, after being originally formed in larger masses. The wall of the enlarged bursa is sometimes thin, at others greatly thickened by the deposit of concentric layers of plastic material within it. In some cases the deposit of plastic matter may go on into the interior of the bursæ, until their walls assume a very great thickness, and almost a cartilaginous hardness, and indeed may continue to increase until the cavity is completely obliterated, and a dense fibrous tumor formed in its place.

Enlarged bursæ are readily recognized; forming, whilst their contents are thin and serous, indolent oval tumors with distinct fluctuation; commonly occurring in the situation of some of the normal bursæ. As they become more solid they become elastic and hard, and often crackle on being pressed when they contain the rice-shaped bodies; but at last acquire all the characters of an ordinary solid growth, as the deposition within them increases. Not unfrequently these enlarged bursæ inflame; or, indeed, an attack of inflammation in them may be the first cause of their enlargement. In either case they become hot and tense, the skin covering them is red, often doughy, and œdematous; and although there is no connection between the bursa and the neighboring joint, yet it may happen that the inflammatory action spreads to the latter, from simple continuity of tissue. Suppuration very frequently occurs in an inflamed bursa; the tension increases, the œdema and redness become more considerable, and the pain assumes a throbbing character. When the bursa is opened, thick pus often mixed with shreds of sloughy tissue is evacuated.

The *treatment* of these bursal tumors must depend entirely upon their nature and actual condition. When inflamed,—rest, the application of leeches, followed by tepid lead-lotions or poultices, and general antiphlogistic treatment will commonly subdue the increased action in them. If suppuration take place, they must be freely opened and the pus evacuated. When in an indolent condition, the surgeon has the choice of various plans of treatment, conducted on different principles. If the sac be thin, the fluid of a serous character, and the disease recent, it may often be removed by blistering, more particularly when it occurs in the ham or under the deltoid muscle. In some cases it may conveniently be obliterated by puncturing the cyst and then employing pressure upon it. The surest mode, however, of closing the sac consists in exciting inflammation in it, either by the injection of the tincture of iodine as recommended by Velpeau, or by passing a small seton through it. The injection is readily effected by tapping the cyst with a moderate-sized trochar and then throwing in about ʒj of the compound tincture. Inflammation will be excited, some discharge will usually take place, and on its cessation the walls of the cyst will have become aggluti-

nated together. In these cases I generally prefer, however, as the most certain method, the introduction of a seton composed of a double silk thread. This may conveniently be passed through the canula after tapping the sac, in the way figured in page 348; a poultice should afterwards be applied, and the threads left in for about six days. Discharge will take place through the aperture by which they have been introduced, and which may, if necessary, be enlarged; the cyst gradually contracts around them, and after their removal it will be found to be closed. When the cyst contains a number of the rice-like bodies, the seton may still be used, but it should be thicker than that just recommended, and the aperture by which it is introduced should be very free in order to admit of the escape of the pus and granules.

If the walls of the cyst are very thick, or its contents semi-solid, or if the tumor have become solid, it must be dissected out. This operation is most commonly required for solid bursal tumors, situated over the patella or the tuberosities of the ischium; from both of these situations they may be removed with facility. In dissecting out these solid bursæ, an operation by the way which is occasionally required on both knees, care should be taken not to make the incisions too wide of the disease; and more especially, to avoid separating the attachments of the fascia of the limb from the edge of the patella, otherwise the layer of cellular tissue leading into the popliteal space will be opened up, and deep infiltration and abscess of the limb, sometimes even of a dangerous character, may result. Enlarged bursæ, especially those situated over the patella, not unfrequently inflame and suppurate; under such circumstances a free incision should be made through their wall and the contents mixed with pus let out.

When the bursa that lies towards the plantar surface of the head of the metatarsal bone of the great toe becomes enlarged, or when a new serous sac is formed upon the inner and posterior aspect of this bone, the disease termed a *bunion* occurs. In this affection the enlargement of the bursæ is usually secondary to an alteration in the shape and position of the great toe, which, in consequence of the pressure of narrow, pointed boots, has been thrown outwards in an oblique direction, so as to lie over, or under, some of the contiguous digits (fig. 244); in this way a sharp angle is formed at the junction between the first phalanx and the metatarsal bone of the great toe. This angle being constantly pressed upon by the boot, becomes irritated, and, for its protection, the bursa that is there naturally situated becomes enlarged, or an adventitious one forms. From time to time the bursa and the projecting angle become irritated and inflamed, and the morbid action thus set up may run on to suppuration of a very troublesome kind, a thin, unhealthy pus being formed, which is discharged through an opening that speedily becomes fistulous, and may degenerate into a most troublesome, indolent sore.

Fig. 244.

In the *treatment* of this affection, the first thing to be done is to change the direction of the toe, by wearing properly-shaped boots. The faulty position, which appears to be the primary cause of the affection, may perhaps be more effectually remedied in some cases, by the division of the external lateral ligament of the metacarpo-phalangeal articulation, or of the tendon of the adductor pollicis, or the inner head of the flexor brevis pollicis; the toe, when restored to its position, being for a time kept fixed upon an under-splint. Pressure upon the bunion may at the same time be prevented, by wearing over it a piece of amadou spread with soap plaster, and perforated in the centre with an aperture corresponding to the size of the tumor. If accidental inflammation

be excited in the part, it must be allayed by the application of leeches, warm foot-baths, and poulticing; the cutaneous irritation that is left may best be removed by painting the surface with a strong solution of nitrate of silver

GANGLION.

Two distinct kinds of ganglion are met with: the *simple*, situated upon the sheaths of tendons, and the *compound*, consisting in a dilatation of the sheath itself. The simple ganglia consists of cysts, varying in size from a cherry-stone to a large marble, and containing a clear transparent fluid of a yellowish color, which is sometimes thin and serous, at others, gelatinous and semi-coagulated. They occur as a smooth, globular, elastic, and tense tumor, usually situated on the back of the wrist, where it forms a distinct round projection; they may also occur on the dorsum of the foot. In both situations, they are distinctly connected with the sheaths of the extensor tendons, and, indeed, Paget looks upon them as being cystic transformations of the fringe-like processes of synovial membrane lining the sheaths of the tendons. As they increase in size, they often give rise to painful sensations in the parts below them, by pressing upon neighboring nerves; thus, a ganglion at the back of the wrist often produces pain and weakness in the hand, by compressing some of the branches of the musculo-spiral nerve that are stretched over it.

The compound ganglia are chiefly met with in the palm of the hand, and the dorsum, sole, or inner side of the foot. They consist of a dilatation of the sheaths of the tendons in these situations, and may often attain a very considerable bulk, and then usually become irregular in shape, owing to several tendons being implicated by them. Often in this form of ganglion, the sheath is simply thickened as well as dilated, and the contained fluid is clear and yellowish, though usually thinner than in the simple ganglion. The sheath itself is vascular, and lined by a red, fringed, and velvety membrane; the fluid may then be dark and bloody, and contain masses of buff-colored fibrine or a large number of granular bodies, like those met with in certain forms of enlarged bursæ. These I have found to be composed of imperfectly-developed granulations, in which the remains of blood-vessels were visible, probably thrown off from the inner wall of the vascular sheath. This form of the disease, at times, puts on almost a malignant appearance, is extremely chronic in its characters, and may occupy a very extensive surface; in a case of the kind that was under my care, some time ago, the dorsum and greater part of the inner side of the foot were involved.

The *treatment* of these diseases must depend upon their character and size. When small and simple, as on the back of the wrist, they may commonly be got rid of by being ruptured by forcible pressure with the thumb, or by a blow with the back of a book, or by being tightly compressed, by means of a six-pence wrapped in a piece of lint, and firmly strapped upon the swelling. If they do not disappear in this way, the better plan is to puncture them by means of a valvular opening, to squeeze out their contents, and then to employ pressure. If they give rise to much pain and weakness, and do not disappear by the means indicated, they may be dissected out, if it be thought advisable to have recourse to this somewhat severe procedure, which is not altogether unattended with the risk of inflammation extending up the sheath of the tendon. I have, however, on several occasions done it, without any troublesome consequences ensuing.

A ganglion situated in the palm of the hand, and extending under the annular ligament some little distance up the flexor tendons of the fore-arm, is a very troublesome disease. Mr. Syme recommends that the cyst should be laid open, and the annular ligament divided. This seems to me an unnecessarily severe procedure, and I have in several instances cured the affection by

milder means; in one, by injecting a small quantity of tincture of iodine into the cyst through a puncture in the palm, and in two or three other cases by the use of the seton; and this is the plan that I should recommend for adoption.

In the side or sole of the foot, these ganglionic tumors, when of large size, and filled with semi-solid fibrinous matter, may require to be dissected out.

Inflammation of the sheath of the tendons — tenosynovitis — is occasionally met with as the result of strains and twists of the hand, about the wrist, of the extensor tendons, or the long head of the biceps. In this affection there is swelling of a puffy character, with tenderness upon pressing upon or moving the part; and usually a peculiar fine crackling sensation is communicated to the surgeon's hand when he examines the affected part. This crackling is especially marked in those cases in which the inflammation and effusion have become chronic, when the disease appears to partake of the nature of a diffused ganglion.

The *treatment*, when the disease is acute, consists in leeching and blistering, with rest of the part; when it is chronic, the application of blisters and the mercury and ammoniacum plaster will be found most useful.

CHAPTER XLVIII.

AFFECTIONS OF MUSCLES AND FASCIÆ.

Strains of muscles, especially of those of the back and loins, attended by pain, weakness, and some rigidity, are not unfrequently met with as the result of sprains or injuries of various kinds, more especially in rheumatic constitutions. They may be best remedied by the use of Corrigan's iron, dry cupping, stimulating embrocations, and the internal administration of colchicum or guaiacum.

CONTRACTIONS AND RETRACTIONS.

Under the head of *muscular contractions* are included various deformities, such as squint, wry-neck, club-foot, club-hand, some of which are congenital, others acquired. In all of these conditions, the deformity is primarily owing to an affection of the muscular system, and not to disease of the bones or ligaments, which are only secondarily implicated. The causes of these deformities are very various, but they may be referred to three heads.

1st. The continuous faulty or abnormal position of a limb, as in an unreduced dislocation, or an anchylosed joint, will be followed by the disuse of a certain set of muscles, which consequently become shortened and atrophied, and acquire a rigid state. This condition is consecutive to the displacement, but renders it permanent; it is apt to occur after fractures, if the parts are kept for too long a time in one position, and more particularly if bound and matted together by the pressure of tight bandages. A somewhat similar cause sometimes operates on the fœtus in utero; an abnormal position in the uterine cavity being very frequently the immediate occasion of some of the varieties of congenital club-foot.

2d. Irritation being set up in the central portions of the nervous system, may produce deformity by deranging the proper antagonistic action of certain groups of muscles. This condition gives rise to many of the congenital, as well as the

non-congenital deformities. It may act by producing more or less complete paralysis of one set of muscles, the contractility of their antagonists continuing normal, and thus the relative balance of action being destroyed, the stronger will draw the part over to their side. The influence of this want of proper balance of parts in paralysis, producing deformity, may be well seen in palsy of the portio dura, where the face is distorted by being drawn to the sound side; or in squint, where the external rectus being paralyzed, the eye is drawn inwards. According to Mr. Tamplin, deformity from paralysis is never congenital, though it is not unfrequently met with in the non-congenital cases. Central irritation may occasion deformity in another way, by producing tonic or permanent spasm of one set of muscles, the other remaining perfect in their contractility, but over-balanced by the continued contraction of their antagonists. This would appear to be the case in some forms of squint.

3d. Peripheral nervous irritation may occasion contraction of the muscles and deformity. This we commonly see happen in cases of contraction occurring from the irritation of worms in the intestinal canal, in the so-called hysterical contractions from uterine irritation, etc. From all these various causes contraction and deformity may arise. In some cases deformity will cease after the removal of the cause; but in other instances, in which it has been of long duration, the deformity will continue, owing to the muscles having fallen into a kind of rigid atrophy, being shortened and wasted, and consequently unfitted for the proper exercise of the actions of the part.

The *general treatment of deformities* consists in removing the cause of the contraction in those cases in which it is dependent on central, peripheral, or nervous irritation that admits of remedy. Thus, if squinting arise from pressure upon the brain, the eye will resume its straight direction when the congested vessels are relieved, or the effused fluids absorbed; or if a contraction of the ham-string muscles arise from the irritation of worms in the intestinal canal, a dose of purgative may cure the affection. When, however, the deformity is of a congenital or more permanent character, the employment of orthopœdic means and the division of the tendons is the only mode of restoring the natural condition of the part. This *orthopœdic* department of surgery owes, in a great measure, its existence to the labors of Delpech and Stromeyer, and its perfection to those of Little and Tamplin.

By *tenotomy*, as at present practised, is meant the subcutaneous division of a tendon by means of a very narrow-bladed knife (fig. 245) introduced obliquely through a puncture by its side. In doing this, it should be borne in mind that the normal anatomical relations of parts are often a good deal disturbed in cases of deformity; and thus tendons may be approximated to arteries and nerves from which, in the healthy condition of the limb, they are widely separated. The tendon may most conveniently be divided, in the majority of cases, by introducing the blade beneath it sideways, and then turning the edge against it, scratching through it by a kind of sawing movement, whilst the parts are

Fig. 245.

made tense by an assistant. A drop or two of blood only are lost in this simple operation, and, as the divided tendon retracts with a kind of snap, a gap will be left between the two ends, of from half an inch to an inch in width, according to the previous amount of tension in the part. If the muscles have been contracted for some years, it will commonly be found that the fasciæ in the neighborhood of the tendon have become rigid and unyielding, forming cords or bands stretching across from the side of the gap. If these are very tense,

they may be divided in the same way; but in many instances it will be found, after a lapse of a short time, that they will yield, and consequently will not require division. After the section has been made, the small puncture should be closed with a strip of plaster or some lint soaked in collodion. The part should then be left without any apparatus being applied for three or four days. At the expiration of this time lymph will have been thrown out, and then proper mechanical contrivances may be adjusted for gradually restoring the normal position of the limb or part; if this be done too soon, the cicatrix will be extended at too early a period after the deposit of the plastic matter, and the division will become weakened and too much elongated. The divided tendon unites like one that has been ruptured, by plastic matter that gradually assimilates to and at last closely resembles its substance. Tamplin states that, on examining the tendo achillis of a boy who died twelve months after it had been cut across, no trace of injury could be noticed, except a slight globular appearance opposite the seat of incision.

In cases of congenital malformation, the question frequently arises as to whether tenotomy should be performed in early infancy, or delayed to a more advanced age. As a general rule, I think that the sooner these operations are done the better; they are not more difficult at an early period of life than at any other, no danger attends them, and by being performed during infancy, there is a far less chance of the deformity being permanent, than if the operation is delayed for some years.

SPECIAL DEFORMITIES.

By *squint* or *strabismus* is meant a want of parallelism in the position and motion of the eyes. Most commonly a squint is convergent, the edge of the cornea being buried under the inner angle of the lids, more rarely the divergent form is met with. In convergent strabismus, one eye only is generally affected, but in some cases both are implicated, though one eye is almost invariably worse than the other; and this gives an appearance as if there were an alternation of squinting in the two eyes. In order to ascertain which eye squints, the simplest plan is to direct the patient to look at a distant object, when the sound eye only will be directed towards it, the affected one being turned inwards.

Squint may arise from a variety of causes; it not unfrequently comes on in children after infantile complaints, such as measles or scarlatina, and as Sir C. Bell has observed, commonly depends upon weakness of the external rectus, owing to some paralytic affection of the sixth nerve, seldom upon spasm of the internal rectus. In many cases it is indicative of disease of the brain or nervous centres, occasioning paralysis or irritation of the motor nerves of the eye; in other instances it may occur from the irritation of worms in the intestinal canal, and not unfrequently is dependent upon some disease of the eyelids or eyeball. Thus the various inflammatory affections of the conjunctiva and eyelids may occasion it; or, it may, as not unfrequently happens, when it occurs in adults, be dependent on the difference in the focal length of vision, owing to amaurosis or the failure of sight in one eye; and lastly, in children it may be induced by habit or imitation.

The *treatment* of squint must to a certain extent be influenced by its cause. Thus the removal of congestion of the brain or the expulsion of worms from the intestines may cure the affection; or, if it have followed simple debility in children, it will disappear as their strength improves, and they will thus outgrow it. If, however, the deformity be of a permanent character, it may readily be remedied by the simple operation that was introduced by Dieffenbach. The operation for squint should not I think be performed until the child has attained its eighth or tenth year, as it is not very easy to do it satisfactorily before this period, owing to the restlessness of infants; and, in very many instances, the

squint gradually disappears as a child grows older without any operative procedure being had recourse to. Indeed, in many cases it may be better to defer it till the adult age is reached. On the other hand, it should not be delayed too long, lest some contraction of the features or deformity in the other eye be left, and thus a very satisfactory result be not obtained. The operation is sufficiently simple; it may most conveniently be done by bandaging the sound eye, and then directing the patient to look outwards with the affected one; a fold of the conjunctiva near the inner canthus is then seized with the forceps, and snipped transversely with a pair of rather sharp-pointed scissors. By dilating the wound slightly with the scissor blades, the tendon of the internal rectus will be exposed, which may be seized with the forceps, and readily cut across; or, a very convenient plan consists in passing a curved director underneath it, raising it upon this, and then dividing it either with the scissors or a small curved bistoury. During the operation the eyelids must be held apart by an assistant, who may if necessary use the eye speculum for this purpose. After the operation, a piece of wet lint should be laid upon the eye, and if any fungous granulations spring from the wound, they must be snipped off or touched with the nitrate of silver; some double vision may be left, but this gradually wears off. Mr Critchett advocates the subcutaneous section of the muscle in strabismus, as being less likely to be followed by those inconveniences and deformities that attend its division in the ordinary way, viz., depression of the caruncle, slow healing, an unsightly cicatrix, and often more or less prominence and eversion, that are as disfiguring as the condition for which the operation is done.

Wry-neck, torticollis, or Caput obstipum may arise either from spasm or from paralysis of one of the sterno-mastoid muscles, the head in the first instance being drawn to the affected side, in the second, to the opposite one. Although wry-neck is usually owing to contraction of the sterno-mastoid muscle, yet in some cases the trapezius is also at fault, more especially its anterior border and clavicular margin. It usually comes on in childhood, and not unfrequently commences with an ordinary stiff neck from cold; after existing for some time it becomes conjoined with a certain amount of twist of the cervical spine, and a tendency to lateral curvature. Besides these, which may be considered the true forms of wry-neck, deformity in this situation may occur from diseased cervical vertebræ, or from the traction of the cicatrix of a burn. These, however, are peculiar conditions depending upon causes that are irrespective of the state of the muscles, and may readily be distinguished from the true form of the disease.

The *treatment* of torticollis arising from permanent spasm of one of the sterno-mastoids, which is the common form of the affection, may best be conducted by dividing the inferior attachment of the muscle, and thus allowing the head to regain its proper position. The division of the muscle is a somewhat delicate operation, on account of the important structures that lie immediately behind it. By making the incision, however, through it, from behind forwards, close to the sternum and along the clavicle, there can, if ordinary care is employed, be little risk of doing any damage, as these bones carry the lower attachment of the muscle forwards, and separate it from subjacent parts. The tension also into which it is thrown by its spasm draws it away from the carotid sheath. In several instances in which I have had occasion to perform this operation, no difficulty whatever has been experienced in dividing the sternal attachment of the muscle, which is usually very tense and prominent, by passing an ordinary tenotome behind the tendon, with its flat side towards it, just in front of the upper margin of the sternum, and then cutting forwards, whilst the muscle is put well upon the stretch. In dividing the clavicular insertion, the safest plan I think consists in making a puncture with a scalpel upon and down to the clavicle in the cellular space, that lies between the two attachments of the muscle, and then pushing a long, blunt-pointed, narrow-bladed tenotome between that bone and the insertion of the muscle, dividing this in a direction forwards. After the

operation the head should be drawn to the opposite side by means of proper apparatus. In this way the curvature of the cervical vertebræ may gradually be corrected; should it, however, have existed for a considerable time, it may have assumed a permanent character; and a twist in the neck will continue for life. After the division of the tendon the deep fascia of the neck will sometimes be found stretching across in firm and tense bands; these, however, had better not be interfered with, as they will generally yield, and much risk of injuring the subclavian and carotid vessels would attend any attempt at their division.

In those cases in which the wry-neck appears rather to be dependent upon paralysis of one sterno-mastoid, than spasm of the other, electricity, and the application of strychnine to the blistered surface over the muscle, will be found most useful. In spasm of both sterno-mastoids, the head is thrown forwards, the muscles projecting in great relief. In these cases the disease will usually be found to have had a rheumatic origin.

Club-foot.—Deformities of the feet are commonly single; but not unfrequently they affect both extremities. They appear to be more frequent in boys than in girls. Four varieties of club-foot are recognized;—the *talipes equineus*, in which the head is elevated; the *talipes calcaneus*, in which the anterior part of the foot is drawn up; the *talipes varus*, in which the foot is twisted inwards; and the *talipes valgus*, in which it is twisted outwards. These conditions may occur in the simple forms just mentioned, but most commonly the varus is complicated with the talipes equines, and not unfrequently the valgus with the calcaneus. Bonnet, of Lyons, has made a classification of talipes, according as it is occasioned by an affection of the internal or of the external popliteal nerve. When the muscles supplied by the internal popliteal are affected, we have the talipes equineus, equineo-varus, and varus. When the external popliteal is affected we have the calcaneus and valgus.

On dissecting a foot affected by talipes, it will be seen that but little alteration has taken place in the condition of the bones. In some preparations of this kind, that are in the University College Museum, these are nearly in a normal condition (figs. 247–250). Indeed, in the talipes equineus and calcaneus, they are scarcely, if at all, altered, but in the varus and valgus, if of old standing, the astragalus will generally be found atrophied, more particularly about its head, which may be somewhat twisted, and the scaphoid and cuboid will be seen to have undergone similar changes. The ligaments are necessarily somewhat altered in shape, being lengthened on the convexity, and shortened on the concavity of the foot; the direction of the tendons is altered, and the muscles not only of the foot, but of the leg and thigh, are generally atrophied from disuse, so that the limb in old cases is withered and shortened; indeed, so great an incumbrance may it occasionally become under these circumstances, that amputation of the leg may be insisted on by the patient, and may with propriety be performed by the surgeon.

Talipes equineus is characterized by elevation of the heel, and great tension of the tendo achillis, so that the foot is extended in nearly a straight line with the leg, and the patient walks on his toes, which are placed at a right angle to the foot (figs. 246, 247). In this deformity there is no lateral displacement. According to Mr. Tamplin it is never congenital. It most commonly arises from disturbance of the nervous system, during teething, or from the irritation of worms in children. In adults it may come on from some disease, such as abscess in the calf of the leg, by which the gastrocnemius muscle is crippled. It is the most important of all the forms of club-foot, as it commonly complicates the other species. The treatment consists in dividing the tendo achillis, and bringing the heel well down.

The tendo achillis is best divided about an inch above its insertion into the os calcis. The patient should be laid prone, and the surgeon grasping the foot

extends it forcibly, so as to throw out the tendon in good relief, and make it tense; he then slides a tenotome beneath it, and cuts slowly through it from beneath upwards, bearing well upon the foot; as the division proceeds, he will hear the tendon cracking as its fibres are successively cut through. The division should never be made from above downwards, as the posterior tibial artery or its malleolar branches might readily be wounded.

Fig. 246.

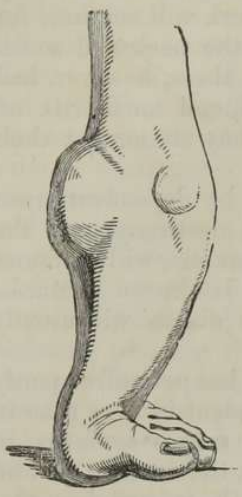
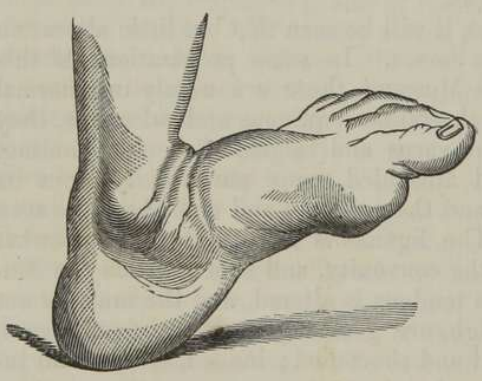


Fig. 247.

The *talipes calcaneus* is an extremely rare variety of club-foot. In it the heel is depressed, the toes and anterier part of the foot being elevated (fig. 248); it is always, I believe, congenital, and arises from contraction of the extensor tendon. In order to bring down the foot, the tibialis anticus, the extensor communis, the extensor pollicis, and the peroneus tertius, may all require to be divided as they pass over the dorsum; a straight splint should then be applied, and the foot drawn down to it. A minor degree of this affection consists in a peculiar projection upwards of one or two of the toes associated with some tension of the extensor tendon; by dividing this, and keeping the foot on a flat splint, this deformity may commonly be corrected. In some cases, however, the toe is so prominent, and the contiguous ones are squeezed under it in such a manner, that the foot is completely crippled, and amputation of the displaced digit is required in order to restore the utility of the member.

Fig. 248.



Talipes varus. — In this deformity the foot is twisted inwards, and the sole is contracted, the patient walking on the outer side of the foot, where the skin covering the tarsal end of the fifth metatarsal bone often become excessively dense and firm, and a bursa occasionally forms (figs. 249, 250). In most cases there is some elevation of the heel, the affection partaking somewhat of the equineus character. It is the most common form of congenital deformity, both feet being found similarly affected; but it may be non-congenital, and then it is limited to one. The treatment consists in the division of the tendo achillis, together with the tendons of the tibialis anticus and posticus, which are the muscles principally at fault. In most cases the plantar fascia is contracted, and requires division wherever it feels tense and projecting. In the section of the tibialis posticus tendon in the sole of the foot there is much danger of wounding the posterior tibial artery, which lies close to it. The best way to avoid this vessel is to puncture the sheath of the tendon with a sharp scalpel introduced directly downwards, and then to divide it in a direction forwards, away from the vessel, with a blunt tenotome. There will also be less risk of this accident

occurring if the tendo achillis be divided first, so that the others may be rendered more tense, before their section is undertaken. But in cutting through

Fig. 249.

Fig. 250.

the tendo achillis there is also some risk of wounding the artery, as in bad cases of varus these two structures lie nearly parallel to one another, the tendo achillis being drawn out of the median line towards the inner ankle. Indeed, in one instance, I have seen the posterior tibial artery punctured during the division of this tendon, or rather in an attempt to divide some tense bands that lay beneath it; the bleeding, which was very free and in a full jet, was, however, readily stopped by pressure, no bad consequences resulting. The proper plan of treatment, when such an accident occurs, is, when the artery is merely punctured, to cut it completely across, and then to apply firm pressure, by means of a pad and bandage, over the bleeding orifice. Mr. Tamplin states that he has seen no ill effects follow this accident. If a circumscribed false aneurism has formed, it must be laid open, the clots turned out, and the vessel tied. No extension of the foot should be practised for some time in such cases, lest the coagulum be disturbed.

In ordinary cases of varus, after a lapse of four or five days, Scarpa's or Little's shoe, or Aveling's Talivert may be applied; or the foot be well abducted by means of a wooden splint, fixed to the outer side of the leg, and provided with pegs, so placed that the toes can be drawn up, and the foot well turned out by rollers and tapes attached to them.

Fig. 251.

Talipes valgus — *flat* or *splay foot* — is the antithesis to varus. In it there is a tendency in the first instance to the obliteration of the arch of the instep, so that the sole becomes perfectly flattened; and as the disease advances, a tendency to eversion of the foot usually takes place (fig. 251). When it has advanced to this extent the toes and anterior part are often somewhat raised, so as to constitute the variety termed *calcaneo-valgus*. In this kind of deformity the ligaments of the sole of the foot, which bind the bones together so as to form the arch, are weakened and elongated, and the peroneal and extensor tendons commonly tense. It is not so frequent a form of club-foot as the other varieties, and commonly affects only one extremity. When both feet are everted there is usually knock-knee as well. The treatment consists in the division of the tendons of the peroneus longus, and brevis, behind the outer ankle; and of that of the extensor

communis on the dorsum. Scarpa's shoe may then be applied, and the arch of the foot restored by wearing a pad under the sole for some considerable time. The talipes calcaneo-valgus is not a congenital affection; and as it commonly arises from a partially paralyzed state of the gastrocnemius, the treatment is not very satisfactory.

In *talipes calcaneo-valgus* the projection of the heel backwards is obliterated, and the outer side of the foot curved round towards this, so that the little toe approaches the point of the heel.

Weak ankles not uncommonly occur in ricketty children; the ligaments being relaxed, the joints appearing to be swollen, and the child unable to walk or stand without great difficulty. Under these circumstances, attention to the state of the general health, douching with salt-water, the application of an elastic India-rubber bandage round the ankle, or the use of light iron supports, will be found most useful.

The deformity termed *genu-valgum, knock or* X *knee*, usually affects both extremities, though it is generally more fully developed in one than the other. In it the knee forms the apex of a triangle, the base of which would be represented by a line drawn from the trochanter to the outer ankle. It is usually conjoined with some curvature of the bones of the leg. It is not a congenital affection, but commonly occurs in consequence of children being put upon their feet too early, the limbs thus giving way under the weight of the body. Brock states that out of 221 cases that he examined, 17 originated about the period of the first dentition; and about 200 between that age and the 15th or 18th year. Some occupations are said to predispose to it, smiths being especially liable to the disease. In it there is relaxation of the internal lateral ligament; the biceps, the external lateral ligament, and often the vastus externus are very tense; and the patella thrown outwards. The external condyle of the femur will generally be found to be small and the hollow of the ham to be obliterated. The treatment consists, in the slighter cases, in applying a well-padded splint along the outside of the leg and thigh; this must extend from the trochanter to the outer ankle, being fixed to a pelvic band at the upper part, and into a boot below. Where it corresponds to the knee it should be provided with a hinge, and should have a broad well-padded strap passing from its under side, over the inner side of the knee, and attached by buckles to the upper part of the splint, in such a way that by tightening these the knee may be drawn outwards. This apparatus should be constantly worn for many months, and if properly adapted may effect a cure.

When the deformity is of old standing, and the parts about the outer side of the joint very tense, the biceps tendon may require division. In doing this care must be taken not to injure the peroneal nerve. In some cases the vastus externus and contiguous portion of the fascia lata may also be advantageously divided, and the padded splint then applied as directed.

CONTRACTIONS OF THE KNEE-JOINT.

Contraction of the knee-joint is one of the most distressing deformities to which the human frame is liable. If severe, the leg is bent at nearly, or perhaps at quite, a right angle with the thigh. It is fixed in this position, so that the patient cannot put the sole of the foot, or even the points of the toes, to the ground; hence the limb becomes useless for the purpose of progression, and, from want of exercise, atrophies. But a leg with a badly-contracted knee is worse than useless — it is a positive incumbrance; for, as the foot cannot be brought fairly to the ground, the limb projects behind in a most awkward manner, swaying as the body moves round, constantly in the way, and liable to injury. From want of exercise, the nutrition of the limb thus affected becomes

impaired; the foot is usually habitually cold, the circulation in it languid, and the toes become liable to chilblains and troublesome ulceration.

In the less severe form of contracted knee, the inconvenience, though not so great as that just described, is yet very considerable; for, as the patient can never bring the heel or sole to the ground, he rests insecurely on the tips of his toes, and walks but unsteadily with the aid of a crutch or stick.

This deformity may be of two kinds — 1st, it may consist of simple flexion of the leg on the thigh, at a greater or less angle, and with more or less mobility, according to the degree of anchylosis; 2d, in addition to this, there may be horizontal displacement of the bones, the head of the tibia being thrown backwards, the femur and patella remaining *in situ*, but apparently projecting more than is natural.

In examining a case of contraction of the knee-joint, the patient should be placed on his face, with the thigh extended. The leg on the affected side will then be raised more or less perpendicularly, and the amount of contraction may be judged of by the angle that it forms with the thigh. The degree of mobility also may readily be ascertained. In this way a more correct idea of the amount of contraction can be obtained than by examining the patient whilst lying on the back, when, in consequence of the thigh being flexed on the abdomen, the extent of the angular deformity cannot be so well determined.

Contraction of the knee-joint may arise from a great variety of pathological conditions. Some of these are altogether external to the joint, being seated in the nerves or muscles of the limb; whilst others, and the majority, are dependent on some morbid change that has taken place within the joint itself in its ligamentous or osseous structures. As the contraction depends on such very varied causes, the treatment, having reference to the cause as well as to the actual morbid conditions, must be equally diversified.

Contraction from nervous irritation is usually associated with general hysteria, of which it is but a local symptom, and commonly occurs in girls and young women. In this form of contraction there is no evidence of disease within the joint; no redness, swelling, or other sign of inflammation; but there is great pain and tenderness about it. This pain, as usual in hysterical cases, is superficial and cutaneous, and radiates to some distance beyond the articulation. Any attempt at straightening the limb not only greatly increases the pain, but also calls the muscles about it into such forcible action that it is impossible to improve its position. These local symptoms are connected with the ordinary signs of an hysterical temperament, with spinal irritation, and often with uterine derangement.

The *treatment* of these cases of *hysterical contraction* of the knee is simple. The first thing to be done is to straighten the limb. This can only be effected by putting the patient under the influence of chloroform, when, all sensibility being suspended, the muscular opposition, which is partly voluntary, and no doubt in some measure reflex, is no longer called into action, and the limb falls of its own accord almost into the straight position, in which it must be retained by means of a long splint, lest the retraction recurs with returning consciousness; and then, the hysterical condition being removed by treatment calculated to improve the general health, the tendency to the return of the deformity will be obviated.

We occasionally see contraction of the knee from spasmodic action of the hamstrings, arising from some irritation applied to the nerves at a distance from the part. Just as we have spasm of the internal rectus of the eye occasioning squint, so long as the irritation that gives rise to the spasm lasts; so we may have spasm of the hamstrings, with contraction of the knee as a consequence.

Most commonly, however, the joint itself is at fault, owing either to inflam-

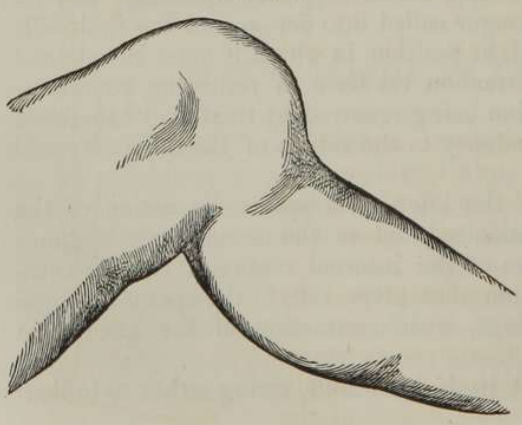
matory action of a subacute character going on within it, or to the chronic and permanent changes induced by former inflammatory attacks.

In inflammation of the knee, the patient naturally and instinctively places the limb in the semi-flexed position, as being that in which there is least tension exercised on the structures that enter into the joint, and consequently that which is most congenial to his feelings. This position, which is immediately assumed on the occurrence of acute and active inflammation in the joint, comes on more gradually in cases of subacute inflammation, and here the symptoms of disease in the joint may be so slight that the contraction may be considered the chief ailment, and engross too exclusively the surgeon's attention.

The next class of cases that we have to consider are those of a more chronic and intractable kind, lasting often for years, dependent upon structural lesions of a deep and important character in and around the joint, and requiring very active surgical interference for their cure. These chronic forms of contracted knee appear to arrange themselves in four distinct varieties, being dependent—1st, on consolidation and contraction of the ligamentous structures in or around the joint; 2d, on permanent contraction of the muscles; 3d, on both these conditions conjoined; and 4th, on osseous anchylosis. Each of these varieties will require separate consideration, as each demands a special mode of treatment for its cure.

Those cases of contraction of the knee that depend on consolidation of the ligamentous structures in and around the joint, resulting from former inflammatory attacks, are not only the most numerous, but the most readily amenable to treatment. In these cases the knee is usually fixed at, or near, a right angle, and admits of but very limited motion, to such a degree only, in most instances, as will allow the foot to move to the extent of two or three inches. The hamstring muscles are not tense, even when the knee is extended to its utmost; and, indeed, in some cases are flaccid, and feel soft. Not unfrequently the leg admits of extension up to a certain point, with as much freedom as natural, and then the further movement of the limb is checked by a sudden stop. If this be not dependent on the tibia coming in contact with an anchylosed patella, it is owing to shortening of the crucial ligaments, or to the formation of adhesions within the joint. In this form of contraction, the knee is often much distorted, owing to the head of the tibia being partially dislocated backwards, or having its axis directed more or less to one side, most commonly inwards, constituting a kind of genu valgum. These distortions are, I believe, dependent on softening and consequent relaxation either of the ligamentum patellæ, or of one or other of the lateral ligaments. When the head of the tibia is displaced backwards, it will most generally be found that the ligamentum patellæ has been either partially absorbed, and thus weakened, or is elongated, the patella being drawn upwards or to one side. In either way the action of the extensor muscles of the thigh upon the head of the tibia is weakened, and that bone being consequently brought under the influence of the hamstrings, without a counterpoise, is drawn backwards (fig. 252). In those cases in which there is lateral rotation of the tibia, the faulty position may have arisen from the attitude that the limb has been allowed to assume during the progress of the disease in the joint.

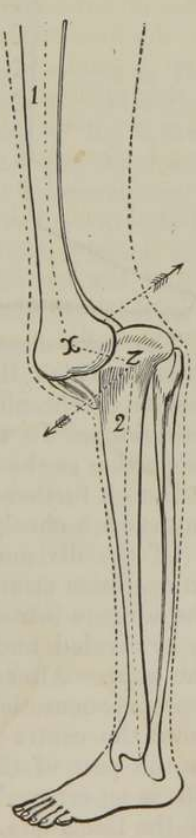
Fig. 252.



In the treatment of this form of contraction of the knee, simple extension of the limb will often prove suffi-

cient. This may either be done gradually by means of the screw splint behind the knee, or forcibly and at once under the influence of chloroform. I prefer the latter method, not only as being the speediest, but as being perfectly safe and effectual. The mode of effecting forcible extension is as follows: — The patient being fully under the influence of chloroform, and lying on his face, the surgeon, standing above him, seizes the foot of the affected limb with one hand, whilst with the other he steadies the limb just above the knee. He now extends the limb gradually but forcibly; as it comes forwards the bands of adhesion in and around the joint will be felt and heard to give way with loud snaps and cracks, distinctly audible at some distance. Should there be much resistance within the joint, the surgeon may apply his own knee or elbow to the upper surface, and thus increase the force with which the limb is acted upon. In this way I have never found any contractions of the kind now under consideration able to resist the surgeon's efforts, or any difficulty in effecting at once the extension of the limb. Nor have I ever seen any evil consequences result; indeed, it is surprising what an amount of force a joint that has been contracted for any length of time may be subjected to without inconvenience. In these cases it would appear as if the synovial membrane lost its susceptibility to inflame, just as we find is the case with serous membranes that have been the seat of chronic inflammation and its consequences. Beyond some pain for a few days, and slight heat, easily subdued by cold evaporating lotions, I have never seen any ill results arise; but then care must be taken that no inflammatory action is going on within the joint at the time of this manipulation, as it certainly would be followed by injurious results. After the extension has been made, the limb should be fixed on a long splint, well padded, some evaporating lotions applied, and the patient kept in bed for a few days, when, with the aid of a starch bandage, he may walk about.

Fig. 253.



After extension has been effected, the position of the head of the tibia backwards may still occasion considerable deformity and weakness of the limb (fig. 253). This condition is best removed by the use of the instrument of which the following sketch (fig. 254) is a good representation, and was designed and constructed by that excellent surgical mechanician, Mr. Bigg. The diagram (fig. 253) represents the limb of a patient whose tibia has become displaced backwards, the angular contraction having been remedied. In the centre of the end of the femur and the head of the tibia, two letters (X and Z) are placed to designate the axis of each bony head, beneath and above which the displaced joint has formed its abnormal axis. The dotted lines represent the leverage formed by the cylindrical surface of the tibia and femur. The arrows are placed in such a direction as the bones would take in resuming their normal position.

It will readily be seen that any instrument capable of acting in the mechanical directions shown by the arrows, would accomplish not only the restoration of the joint, but extend, if contracted, the extremities of both femur and tibia.

Fig. 254 shows the application of the instrument by which this can be effected.

An additional advantage that this instrument possesses over any other with which I am acquainted, is the application of spring power, by means of which flexion of the knee becomes an element towards its restoration.

Instead of arresting muscular action, and thus giving rise to atrophy of the limb, movement is conducive to the perfect action of the apparatus, so that the patient experiences but little inconvenience from its use, all the ordinary positions assumed by the knee in walking, sitting, or standing, being preserved.

By this form of apparatus, then, three important points are secured, viz.: replacement of the head of the tibia; extension of the angle of the leg; and free muscular action during the period of treatment.

Fig. 254.

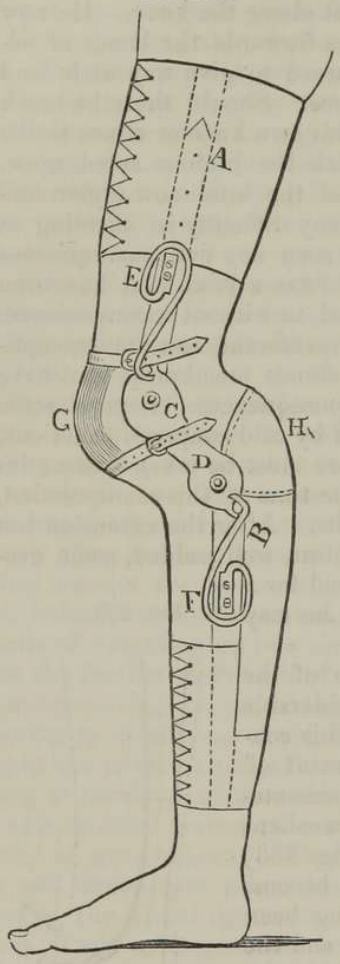


Fig. 254. A and B are three levers, composed of metal, corresponding in their direction to the perpendicular position of the femur and tibia. C and D are two axes, placed exactly coincident with the centres of the articular ends of the bones. E and F are two powerful springs, whose action takes place in opposing directions, similar to the arrow-indicators in fig. 253. Thus F presses the lever B in an anterior direction, bearing the end of the tibia forward, whilst E presses the lever A in a posterior direction, bearing the end of the femur backward. As C and D are found acting above and below the actual axis of the knee-joint, they mutually influence the point formed by the apposition of the heads of the tibia and femur; and as it has already been explained that the femur really offers a fixed resistance, and the tibia moves beneath it, the head of the latter bone is turned anteriorly in a semi-circular direction consequent on the upper centre (C) being a fixed point, and the lower centre (D) rotating around it. G is an elastic knee-cap; H, a padded plate. When the ligaments are tense, there is a chance of pressing the anterior surface of the tibia against the posterior surface of the femur. This is readily obviated by having the shaft (A) made to elongate, when the centre (C) being a little lowered, pushes the lever (B) downwards, carrying the tibia with it and thus separating the osseous surfaces of the joint.

The next class of cases of contracted knee that we have to consider are those in which the hamstrings are at fault, either alone or in addition to those results of chronic inflammatory action within the joint that we have just been describing. In these cases the hamstrings will be found to be tight, and in proportion as the leg is extended on the thigh, they will become tender, until at last all further extension is resisted, apparently by their traction, and not by any sudden check or stop within the joint itself.

Of the division of the hamstring tendons I need say little. It is as simple an operation as any in surgery, unattended by any difficulty or danger, provided the surgeon introduces the tenotome parallel and close to the side of the tendon to be divided, and cut in a direction from the inside or popliteal aspect towards the skin. After the division of the tendons, it not unfrequently happens that tense aponeurotic bands will be found to stretch along either side, or perhaps down the centre of the popliteal space. This may lead to the erroneous idea on the part of the surgeon that he has not fairly cut the tendons across; but this is an error. The bands alluded to are condensed, sharp-edged prolongations of the fascia lata, formed during the period of contraction of the joint by the

retraction and thickening of this membranous expansion. Such condensations as these had better be left untouched, as they will readily stretch out under gradual extension, or be ruptured by forcible traction of the limb. If, on the other hand, the surgeon be tempted by their apparently superficial and safe position to proceed to their division, he may be led into a serious dilemma by being brought more readily in contact with the popliteal vessels than is desirable or safe. In these cases the anatomical relations of parts are so much altered by the narrowing of the popliteal space, and by the projection of the head of the tibia backwards or by its lateral rotation, that the surgeon is unable to calculate with sufficient nicety the precise position of the large vessels and nerves in the neighborhood of which he is about to act, and he might thus injure one or other of these at a time that he thought he was operating at a safe distance from them.

After the division of the hamstrings, the knee does not commonly come readily into the straight position, but forcible extension will be required to break through the adhesions within and around the joint. This may be done at once without inconvenient results, or it may be deferred for a week if the surgeon thinks better to delay extension after tenotomy.

Osseous anchylosis of the knee is not of very frequent occurence. The only remedy in such cases would be the operation practised by Dr. Rhea Barton, — of sawing out a wedge-shaped portion of the anchylosed bones, and then bringing the limb into the straight position. Judging by the excellent results that have followed resections of the knee-joint, such an operation is not unlikely to be attended by good success. Should there be much atrophy of the limb with shortening of it, and possibly necrosed bone with old sinuses and occasional abscesses about the knee, amputation will place the patient in the condition of most comfort.

DEFORMITIES OF THE ARM AND HAND.

Contractions of the arm are not of very frequent occurrence, except as the result of burns. I have however met with three distinct forms of contraction of the fore-arm: — 1st. The case in which there is anchylosis of the elbow-joint, the fore-arm being bent usually at a right angle with the arm, the result of chronic disease of the articulation. Here, if the anchylosis be incomplete, a very useful limb may be restored by breaking down adhesions under chloroform by forcible flexion and extension, and then using passive motion, friction, and douches. If the anchylosis be complete, the bones should be resected, and a false joint allowed to form. 2d. The biceps may by its contraction occasion a permanent flexion of the arm. In such cases division of the tendon may be practised, due care being taken of the artery and nerve. This operation is most safely done by introducing the tenotome to the inner side of the tendon, slipping it under, and cutting upwards and outwards, the artery being guarded and pushed to the inner side by the pressure of the left forefinger. 3d. The fore-arm may be forcibly pronated and flexed as the result of chronic inflammation of the radio-humeral articulation. Here forcible supination and extension under chloroform is the best remedy.

A deformity resembling club-foot has occasionally, though very rarely, been met with in the hand. The contraction may occur in two directions; either in the sense of preternatural flexion, or in that of abnormal extension of the member. It is always congenital, and has been principally described by Cruveilhier, Voillermier, and Smith of Dublin. In most of the cases that have been met with, there was a certain amount of deformity of the lower end of the radius, with congenital dislocation of the wrist; and in Mr. Smith's case there was an accessory semi-lunar bone in the carpus. Little, if anything, can be done by surgery for the relief of this deformity, though some benefit might

possibly result from the division of any tendons that were preternaturally tense.

A tendency to contraction of the fingers, which are drawn into the palm of the hand, is occasionally noticed; most commonly this commences in the little finger, and thence gradually extends to the ring or middle finger, which become so forcibly and firmly curved inwards, that their extension is not practicable. It commonly results from frequent and continued pressure on the palm of the hand, as in leaning on a round-ended stick in walking, or in those trades in which an instrument requires to be pressed into the hollow of the hand. On examining the contracted fingers, projecting ridges will be felt extending from the palm to their anterior aspects; and on endeavoring to straighten them, these ridges will be found to become stretched, and the palmar fascia to be rendered tense. The skin covering these ridges is usually healthy, but sometimes adherent to them. So firmly are the fingers contracted, that by no effort can they be extended.

The cause of this contraction of the fingers has given rise to a good deal of difference of opinion amongst surgeons. Dupuytren appears to have been the first who endeavored, by dissection, to ascertain its true character. He found, on examining a hand that was the seat of this disease, that after the removal of the skin, which was loose and flaccid, the contraction continued as before, and this, therefore, could not be its seat; but that the palmar fascia, which was exposed, was tense and diminished in size, whilst, from its lower aspect, some cord-like prolongations passed up by the side of the fingers, and that when these were divided, the contraction was immediately removed, the tendons, the bones, and the joints being perfectly sound. He considered these fibrous cords to be the digital prolongations of the palmar fascia, and consequently looked upon this membrane as the seat of the disease. M. Goyrand, who has carefully dissected hands affected in this way, states that these fibrous cords, which he also looks upon as the seat of the affection, are not prolongations of the palmar fascia, but are ligamentous structures that extend from its anterior inferior aspects to the sheaths of the flexor tendons, into which they are inserted opposite the second phalanx; being an hypertrophied condition of the subcutaneous filaments of fibro-cellular tissue that naturally exist in this situation.

The *treatment* of this deformity consists in dividing each tense digital ligamentous prolongation by a subcutaneous incision. This should be done opposite the second phalanx, where it is usually most tense; but, if the other finger-joints be affected, a separate section may be required opposite each phalanx. Should the skin be adherent to the fibrous band, it must be divided with it, and the finger then extended.

DISEASES OF REGIONS.

CHAPTER XLVIII.

DISEASES OF THE HEAD AND NECK.

FUNGUS OF THE DURA MATER.

Sometimes without external or apparent cause, at others in consequence of a blow or fall, a fungous tumor grows from some part of the dura mater, usually on the vertex or the parietal regions. As it increases in size it produces absorption of the cranium covering it; the bone becomes thinned and expanded, crackles like parchment on pressure, sometimes without being raised above its proper level, but more usually pushed up by the pressure of the growth beneath, which at last protrudes under the scalp. More usually this perforation of the cranium is gradual, but in some cases it would appear to have been sudden, the first intimation the patient had of the existence of disease being the presence of a tumor under the scalp. When the skull is perforated, the sharp edges of the circular opening can be distinctly felt; and the tumor that protrudes pulsates distinctly, as evidenced both by the finger and the eye.

Symptoms of cerebral disturbance,—loss of sight, double vision, deafness, or epileptic fits, with fixed pain in the head, — usually precede, for a considerable time, the external appearance of the tumor. In some rare cases no such symptoms indicated the existence of intra-cranial disease, and the first evidence of the disease has been the sudden protrusion of a pulsating tumor through the skull. If the tumor is compressed, and especially if attempts be made to push it back under the bone, giddiness, syncope, and convulsions are produced; and as the disease makes progress, death from paralysis and coma ensues.

The result of the treatment of fungus of the dura mater is not very satisfactory; but yet as the disease would appear to be almost of necessity fatal, if left to itself, something should be attempted, not, however, until the tumor has fairly appeared through the bones. The scalp covering it should be turned back by a crucial incision, and the tumor exposed. The aperture in the skull through which it has protruded, may then, if necessary, be enlarged by the use of the trephine, or Hey's saw, so as to lay bare the full extent of the base of the tumor, which must then be carefully dissected away from the dura mater.

Fungus of the cranium may occur which at first closely resembles the disease just described. It differs from it, however, in this respect, that the tumor is devoid of pulsation and cannot be pushed back. It is vascular, in structure resembles the pulp of a red gooseberry, or a broken-down mulberry. In a case of this kind which I had an opportunity of seeing some years ago, the growth was successfully removed by my friend Mr. B. Phillips.

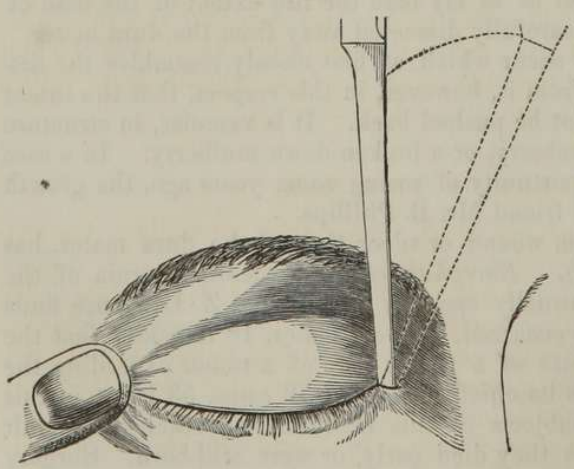
Hernia Cerebri, resulting from wound or ulceration of the dura mater, has already been described (p. 290). *Encephalocele* or *congenital* hernia of the brain is a rare malformation, usually speedily fatal. Mr. Z. Lawrence finds that of 39 instances in which it occurred, 21 were males, 18 females; that the protrusion may vary from the size of a pea to that of a tumor exceeding the child's head; that the occiput is its chief seat, — of 79 cases, 53 being in this situation. In 6 instances, the subjects of this malformation reached an adult age; in all the remaining cases they died early, or were still-born. Surgery offers little in these cases, though in one instance the protruding portion of brain was successfully sliced off, the patient surviving.

Encysted Tumors of the Eyelids.—Small cysts are not unfrequently met with, lying between the tarsal cartilage and the conjunctiva. At first they occasion no inconvenience, but as they increase in size they cause the conjunctiva covering them to become injected, papillated, and granular, thus at last occasioning a considerable amount of irritation and lachrymation. These tumors may be removed either by being dissected out, or by being obliterated by inflammation set up in them. If the tumor is to be dissected out, the eyelid must be everted, and the cyst, having been exposed by dividing the conjunctiva covering it with a fine scalpel, must be drawn forwards with a hook and removed by a few touches of the knife. This little operation is, however, at times somewhat troublesome, and in preference to it I always induce the obliteration of the cyst by exciting inflammation in it. This may most conveniently be done by everting the lid, and then making a crucial puncture into the cyst with a lancet; the contents having escaped or been squeezed out, and the part well dried with a piece of lint, a pointed silver probe dipped in nitric acid should be quickly introduced through the puncture, the inside of the cyst stirred up and a little sweet oil having been poured over the lid, it may be replaced. Some induration will be left in the site of the cyst for a few weeks, but as that subsides the tumor will be found to have disappeared.

Puncture of the Lachrymal Sac.—This operation is frequently required in those cases in which, the nasal duct having become obstructed, the lachrymal sac becomes distended by the accumulation of the tears, inflames, and either threatens suppuration, or, having given way, a fistulous opening has been left, below the under angle of the eye, through which tears often escape—the ordinary *fistula lachrymalis*. If a fistula have not already formed, the sac being merely distended, the passage through the nasal duct may sometimes be restored by the careful introduction of a very fine silver probe into it through the puncta, or the sac may be injected through the same orifice by means of one of Anel's syringes. Should these measures not prove successful, the permeability of the duct may be restored by catheterism from below; for this purpose a steel probe or sound, bent nearly to a right angle at about one inch from the extremity, should be passed into the nostril beneath the inferior turbinate bone; by a slight to and fro movement, the point of the instrument may be made to enter the orifice of the duct, and then by directing the handle downwards and inwards it will pass up along the canal into the lachrymal sac.

Should these means, however, not prove successful in restoring a passage for the tears, or should a fistula have formed, the sac must be punctured and a style passed into it from above. This operation may be performed in the following way. The patient's head being well supported, on the breast of an assistant, and the lower eyelid having been put well on the stretch by traction with the finger at the outer angle, the surgeon feels for the tendo oculi, the under surface of which is the guide into the lachrymal sac. In many cases, however, owing to the swelling and induration of parts this tendon cannot be felt, and then the guide must be the edge of the orbit below and a little to the outer side of the puncture. Having ascertained this, he rests the little finger on the cheek, and holding a strong

Fig. 255.



narrow-bladed bistoury between the fore-finger and thumb, with the flat of the blade parallel to the face and the edge turned outwards he passes the point downwards and inwards well under the tendon of the orbicularis, the handle resting against the middle or outer third of the eyebrow (fig. 255). He then, by carrying the handle inwards and somewhat forwards until it rests against the bridge of the nose, causes the point to take a direction backwards, downwards, and slightly inwards, for about three-quarters of an inch, when the nasal duct will be fairly entered, which may be known by the bistoury supporting itself. The style may then be introduced along the blade, which should be firmly pressed inwards.

Extirpation of the Eyeball.—This operation may be required for cancer of the eyeball, either of an encephaloid or melanotic character (fig. 256). It is also occasionally called for when in consequence of injury or disease one eye has become disorganized and the vision of the other is sympathetically affected, and can only be preserved by the removal of the globe that is already useless. The operation may be performed in the following way:—

Fig. 256.

The surgeon standing in front of the patient, makes an incision through the outer commissure of the lids as far as the edge of the orbit. The eyelids are then well everted and held apart with a wire speculum. The surgeon next passes a double hook into the globe and draws it well forward; then with a curved broad pair of scissors he divides the conjunctiva at its upper part, and then proceeds to cut across the several muscles of the orbit, and lastly the optic nerve. Should any of the structures within the orbit now present an unhealthy or suspicious appearance he clears them out. The hemorrhage, which is usually rather abundant, may be readily arrested by a pledget of dry lint pressed into the orbit and retained by means of a circular bandage.

If the lachrymal gland is diseased, it must of course be removed with the eyeball. If sound, it may be left, as it atrophies and gives no trouble.

Extirpation of the lachrymal gland may be required for cancerous degeneration. This operation may be performed from the outer or from the inner side of the lid. Whenever practicable it should be done from the inner aspect. It may be performed in the following way: The outer commissure of the lids having been divided as far as the edge of the orbit, the upper eyelid is everted by an assistant; the surgeon then divides the conjunctiva covering the tumor, and fixing a hook in it draws it forwards, and with a few careful touches of the knife divides its attachments. After the removal of the tumor the lid drops into its normal position, and the commissure is closed by a suture.

DISEASES OF THE EAR.

Inflammation of the external ear, otitis, or ear-ache, is usually a rheumatic affection, and is characterized by intense pain, generally associated with hemicrania—a kind of combination, indeed, of inflammation and neuralgia. This pain is much increased at night by warmth of the bed, and is generally accompanied by throbbing and noises in the ear. The treatment, at first antiphlogistic, generally and locally, may advantageously, after a time, give place to quinine and the iodide of potass, with the external application of aconite. Occasionally the affection runs on to the formation of abscess in the meatus externus, attended by excessively painful throbbing. With the view of relieving this, leeching, poulticing, and early lancing will be required.

Otorrhœa, a fetid discharge of a muco-purulent character, usually occurring in strumous children, and often associated with enlarged glands under the angle of the jaw, may be of two kinds; either proceeding simply from the mucous surfaces and being inflammatory, or it may be connected with necrosis of the petrous portion of the temporal bone, being associated with disease and destruction of the tympanum, and necessarily of the internal ear. In the first case, astringent injections containing some of the chlorides in solution may advantageously be used, and will commonly arrest it. If, however, it proceed from disease of the bones, it is necessarily of a far more serious character, and the membranes at the base of the brain becoming irritated by the extension of the morbid action to them, convulsions and death usually eventually result. In some of these cases, phlebitis of the sinuses and of the cerebral veins ensues, and proves fatal to the patient.

The external ear is occasionally the seat of special affections; thus, in idiots, hypertrophy of this structure is occasionally met with; and in gouty subjects, tophi, or gouty concretions, are occasionally deposited in it. Paget, Bruck, and Panzetta have described a fibrous tumor that occasionally forms in the lobule of the ear, from the irritation produced by piercing it, and as "one of the penalties attached to the barbarism of ear-rings." These tumors are of a semi-malignant character, like the warty growths of cicatrices, and, after excision — which is their only treatment — are somewhat apt to return.

We not uncommonly find that the meatus becomes blocked up by accumulations of wax, dark, indurated, and pipe-like; or forming balls and masses that lie in contact with the tympanum. These chiefly occur in individuals of the bilioso-phlegmatic temperament, and are a common source of temporary deafness amongst young people. They not only impair the sense of hearing materially, but are very apt to give rise to noises in the head, and crackling sensations on opening and shutting the mouth. Their presence is best ascertained by examination with a well-constructed ear-speculum; those introduced by Mr. Toynbee, of a double convex shape, are the most useful. The treatment of these concretions consists in softening the wax by the introduction of a little glycerine into the ear for a few nights, and then repeatedly washing out the meatus by the injection of tepid soap and water, or water containing a little soap liniment, thrown in with a large syringe; as the fluid regurgitates from the tympanum, it will at length bring away the dark and hardened ceruminous masses.

Polypi are occasionally met with, situated rather deeply on one side of the meatus: they are usually hard and fleshy looking, though sometimes soft and gelatinous, as in the nose; sometimes pediculated, but at others situated on a broad base, they produce serious inconvenience by obstructing the external ear, and require to be pulled off by means of forceps, or, if too firmly fixed for this, cut off with scissors; the surface from which they spring should then be touched with the nitrate of silver, so as to prevent a recurrence of the growth.

Occasionally the cuticle of the external ear, and that covering the tympanum, becomes thickened and indurated, assuming a dull white appearance, which then may give rise to some amount of deafness. Under these circumstances, glycerine, the citrine ointment, or the solution of the nitrate of silver, will be extremely useful in restoring the healthy action of the integument of the part.

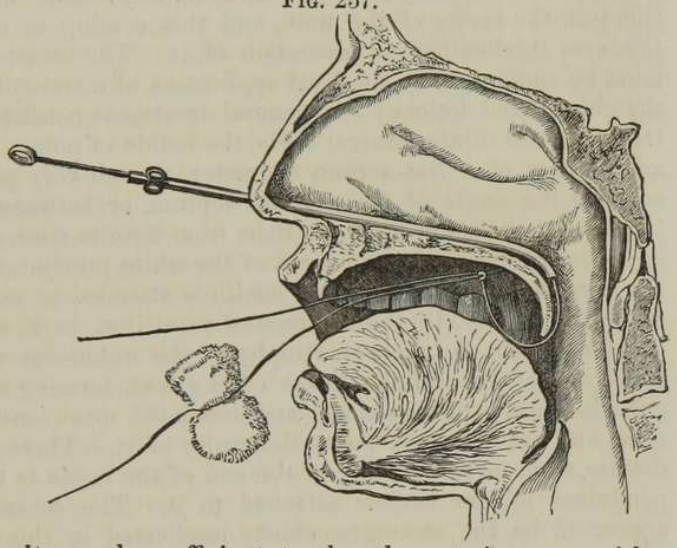
It is not my intention to enter into the general pathology of the various kinds of deafness, or to discuss the causes of this affection. It may be stated generally, however, that it may arise from obstructions of the external ear from disease, ulceration and perforation of the tympanum, from various inflammatory affections, chiefly of a subacute and chronic character, of the internal and middle ear; from paralysis of the acoustic nerve, dependent on cerebral lesions, or local paralysis; and, lastly, from obstruction in the Eustachian tube, or from disease of the throat. Mr. Toynbee has especially shown that many cases of so-called

"nervous" deafness, together with singing, ringing, boiling, and other noises in the head, are in reality dependent upon chronic inflammatory affections of the internal and middle ear, and that the treatment best adapted for their cure consists in constitutional and local means of an alterative and antiphlogistic character.

DISEASES OF THE NOSE.

Epistaxis, or bleeding from the nose, is very common in children and in young people about the age of puberty, more particularly in girls antecedent to the menstrual period; it may either be of an active or passive character, but is most usually dependent on congestion of the mucous membrane. It may commonly be stopped without much difficulty by the use of domestic remedies, but occasionally it is so copious, amounting to many ounces, as to exhaust the patient and to require surgical interference. In the majority of cases the application of cold water and ice to the forehead and bridge of the nose, with rest, and a free aloetic purge, will arrest the bleeding. If, however, it do not stop in this way, it will be necessary to plug the nostrils. In many cases it may be sufficient to plug the anterior nares with a pledget of lint; very commonly, however, the posterior nares require to be plugged as well. This is best done by carrying a long piece of strong whipcord along the floor of the nose through the posterior nares into the pharynx, by means of Bellocq's sound; or, if this be not at hand, by threading the cord through an elastic catheter, and carrying this into the pharynx, then seizing the cord as it appears behind the soft palate, and drawing it forwards into the mouth, at the same time that the catheter is taken out of the nostril. In this way the string will pass through the nose, round the back of the soft palate, into and then out of the mouth (fig. 257). To the centre of the piece of string that hangs out between the lips, a plug of lint, about the size of the end of the thumb, should be firmly tied; this is then drawn up into the posterior nares by pulling on the end of the ligature that hangs from the nose, being guided in its passage behind the palate by the fingers introduced into the mouth. When the bleeding has ceased, it may readily be withdrawn by means of the string that hangs out of the mouth.

Fig. 257.



The mucous membrane of the nose is not unfrequently chronically inflamed, especially in strumous children; that portion of the membrane covering the turbinate bones becoming thick, soft, and vascular, and projecting like a broad fringe from their surface. It is usually of a bright-red color, and covered with muco-pus. This swelling at all times produces snuffling and a peculiar intonation of voice, but increases in wet weather, and then may become so great as seriously to obstruct the breathing. The treatment consists in attention to the general health; more especially to the eradication of the strumous diathesis Much benefit may also be derived by the local application or injection of astringents, as a strong solution of the nitrate of silver applied by means of a camel's

hair brush, and sulphate of zinc and oak-bark lotions snuffed up, or injected by means of a proper syringe. In many instances, when this disease occurs in strumous children, change of air will effect the greatest amount of benefit.

Abscess occasionally forms either on the mucous membrane or on the septum, and thus may lead to necrosis of the cartilages and bones, with much discharge and fetor, separation of these, flattening of the nose, depression of its bridge, and great deformity. These various forms of abscess, followed by necrosis, are commonly syphilitic, and then are associated with ulcers and a foul and fetid discharge, which has a tendency to cake upon their surface, forming dark and rugged crusts, and constituting the different kinds of *ozæna*. The septum may be the seat of chronic ulcerations consequent upon the irritation of decayed teeth, producing disease of the antrum, and escape of morbid secretion from this into the cavity of the nose, and this coming in contact with the septum, produces thickening and ulceration of it. The treatment of these conditions must be conducted by the local application of nitrate of silver, black wash, and the chlorinated lotions; the general treatment consists usually in the administration of the dilute mineral acids, the iodide of potass, and sarsaparilla. Ulcers and fissures of a less serious character, though very painful and chronic, often occur at the angle of the ala and septum, or between the ala and tip; their treatment consists in touching them from time to time with the nitrate of silver, or in the application every night of the white precipitate or citrine ointment, at the same time that the general health is attended to, cachexy removed, and the strength restored, by the administration of iron, bark, and sarsaparilla.

Lipoma is a chronic hypertrophy of the cutaneous and subcutaneous structures, and of the cellular tissue of the nose, forming a large reddish-blue, vascular-looking, soft, tremulous, and lobulated mass, enveloping the end of the nose, and producing excessive deformity of it. There are all degrees of this disease, from mere clubbing of the end of the organ to the formation of a set of pendulous lobular tumors attached to it. The sebaceous glands and crypts appear to be the structures chiefly implicated in this disease. The patient's appearance may be greatly improved by the removal of these growths. This may be done readily enough by making an incision down the mesial line to the alar cartilages, and then dissecting it off these on either side; especial care, however, being taken in doing this not to encroach upon the nostril. This is best avoided by directing an assistant to keep his finger in it whilst the dissection is being prosecuted, so that he may warn the surgeon of the too near approach of the knife. The surface is then left to granulate and cicatrize.

The nose is frequently the seat of *lupus* and various forms of *epithelial cancer*, many of the deformities of this feature being referable to this affection; indeed, lupus may be looked upon as almost specially affecting this organ, destroying one or both alæ, the columna, or perhaps the whole of the nose. The consideration of the nature and treatment of these affections in this situation presents nothing special; but that of the cure of the deformities induced by them, which is full of interest to the surgeon, will be considered in detail when we come to speak of the plastic operations that are practised on the face.

Tumors of very different structures and composition are met with in the nostrils, and to all of these which possess the common characters of being pendulous and blocking up these passages, the term *polypus* is given. Thus surgeons commonly speak of the *benign*, the *soft*, the *gelatinous* or *mucous* polyp, as well as the *sarcomatous* or *fleshy*, and the *malignant* polyp. The term however should properly be confined to a soft and pendulous mucous growth, the fleshy and malignant polypi being merely varieties of fibrous or encephaloid tumors, springing from the bones in the nasal fossæ, or from the ethmoidal and sphenoidal cells.

The true *mucous nasal polyp*, is a soft, moist, gelatinous tumor, of a greyish-yellow color when lodged in the nasal fossæ, but when it descends into the ante-

rior nares, or beyond them, and is exposed to the air, it becomes of a reddish-brown or purple tint, and somewhat shrivelled on the surface. It is usually lobulated, pedunculated, or bottle-shaped, and not very vascular except at the root, where it is permeated by largish thin-walled vessels that bleed freely on the slightest touch. In structure it is homogeneous, and composed of the elements of mucous membrane, covered by tesselated and ciliated epithelium, the ciliæ of which may often be seen under the microscope in active movement after the removal of the growth, beating about the blood-corpuscles and fluid in which it lies. These tumors may grow from all points of the surface of the turbinate and ethmoid bones, and have indeed occasionally, though very rarely, been observed to project into the nose from the frontal sinuses and antrum. Most frequently they grow from the inferior spongy bone towards the outer side of the nostril, sometimes from the roof of the nares, but never take their origin from the septum. These polypi are usually numerous and of all sizes; as they increase, they commonly extend forwards into the anterior nares, but when of large size, they may be seen to reach into the posterior fauces, hanging down behind the palate.

The *symptoms* occasioned by the presence of these polypi, depend on their interference with respiration and speech; and on the visual changes they occasion. The respiration through the affected nostril is impeded, the patient being unable to blow through it when directed to do so, and his speech is thick and nasal. There is snuffling and mucous discharge from the nostril, and all these symptoms are worse in damp than in dry weather. On examining the interior of the nose, by opening the nostril widely with the forceps or nasal speculum, and then directing the patient to blow down, the lower end of the polyp may be distinctly seen, and if large, will descend on a level with, or even beyond the nasal aperture. By the introduction of a probe, the size and extent of the tumor, together with the position of its pedicle, may be readily ascertained. As it grows, it impresses changes on the shape of neighboring bones, producing expansion and flattening of the nose, inducing caries of the spongy bones, and, interfering with the flow of tears down the nasal duct, occasions a watery state of the eyes, which, together with the change of shape in the features, and the peculiar character of voice and respiration, enables the surgeon at once to recognize the nature of his patient's disease. Polypi chiefly occur in young adults after the age of puberty; but they are not unfrequently met with at later periods of life.

The diseases with which nasal polypi may be confounded are, 1st. Chronic thickening of the mucous membrane covering the spongy bones; from this the absence of any pedunculated growth around which a probe can be passed, together with the florid red character of the thickened membrane, and the fact of this almost invariably occurring in strumous children, are sufficient to distinguish them. 2d. Abscess of the septum; from this the history of the case and the fact of the polyp never being attached to this part of the nose, will establish the diagnosis. 3d. There is a peculiar malformation of the septum consisting in a deviation of it to one side, that may at first be a little puzzling; but here the examination of both nostrils and the discovery of a depression on one side of the septum corresponding to the projection on the other, will reveal the true nature of the case. 4th. The fibrous and malignant tumors of the nostril will be found to differ sufficiently in consistence and appearance from the ordinary polypi to prevent their being confounded with them in many cases; but yet in some instances, much care will be required in coming to a definite opinion as to their true nature.

Nasal polypi may generally be most readily removed by avulsion, with forceps; occasionally, but rarely, when they are very large with a broad base, and especially when extending into the throat, they require the application of the ligature. In removing these growths by the forceps, instruments of good length

but very slender construction should be used, those generally sold are too thick; the interior of the blades should be properly serrated, and have a longitudinal groove, so that the root of the tumor may be tightly grasped. The patient should be made to sit on rather a low chair, and as there is generally a good deal of bleeding, a towel should be pinned over his clothes, and a basin placed before him to receive the blood and expectorated matters. The surgeon then having ascertained by the introduction of a probe, or by means of the blades of the forceps the situation of the pedicle of the polyp, grasps this firmly and pulls it off with a twisting movement of the hand. He proceeds in this manner, twisting off rather than pulling away polyp after polyp, until the whole of the nostril is cleared, which may be ascertained by examination and by directing the patient to compress the sound, and to blow through the affected side of the nose. The bleeding, which is often very free, stops on the application of cold water. At about the end of a fortnight the patient should be examined again, as it not unfrequently happens that small polypi, which had been prevented descending into the nares by the presence of the larger ones, now come down and require removal. These procedures must be had recourse to from time to time until all tendency to fresh formations of this kind has ceased.

The ligature is chiefly required for those polypi that pass into the pharynx through the posterior nares. They may best be tied by passing a loop of strong whipcord, by means of a double canula, through the nose, and then, expanding the noose round the tumor in the throat and making it grasp its pedicle, knot it tightly. In some instances the polypi attain a great size, producing absorption of the nasal bones, of the nasal process of the superior maxilla. In such cases it may be necessary, in order to extract them, to slit up the nose and possibly clip away with forceps the osseous surface from which they spring.

The *fibrous polypi* may grow to a large size, extending into the throat, and, perhaps, finding their way from the nose into situations where they are little expected. Thus they have been met with in the pterygo-maxillary fossa, and have been known to pass into the orbit through a hole in its inner wall.

Malignant tumors of an encephaloid character occasionally form in the nostrils, chiefly in children and young people, and, being attended by great expansion of the bones, with a fetid discharge of bloody matter and disintegrated portions of the growths, may end by speedily exhausting the patient. In such cases the surgeon may make an attempt to extract the growth by slitting up the nose, but it is seldom that anything very effectual can be done by operation, and it should be borne in mind, that some of the malignant growths that project into the nostrils take their origin from inside the cranium, or the sphenoidal cells, and that the nasal portion is only the external protrusion as it were of a deeply-seated tumor.

Calculi are occasionally met with in the nasal fossæ, where they simulate a foreign body; and here extraction may be practised with a pair of forceps. But sometimes these *rhinolites* are situated under the mucous membrane. In two cases I have dissected round calcareous bodies of this kind, about the size of cherry-stones, from under the mucous membrane of the ala of the nostril in children.

The *frontal sinuses*, though rarely, are occasionally the seat of disease. Abscess may form here with much pain and expansion, and possibly caries of their anterior wall, attended by the local signs of inflammation and with danger of concomitant inflammation of the membranes of the brain. Under such circumstances it may be proper for the surgeon to consider the advisability of removing by a small trephine the anterior wall of the sinus, and thus giving exit to the retained pus. There are a few cases recorded in surgical writings, of polypi springing from these sinuses, and finding their way down into the nose after producing expansion of it and much inconvenience. Here

likewise the propriety of trephining and so extracting the morbid mass would have to be considered.

The *cheeks* are occasionally the seat of encysted tumors and cancerous growths, either springing from their inner surface, or taking their origin as lupoid ulcers on the outside. The encysted tumors in this situation may readily be removed by a little simple dissection. The cancroid ulcers and tumors, such as represented in fig. 258, seldom admit of operative interference.

Fig. 258.

One of the most troublesome surgical affections situated in the cheek, is a *salivary fistula*, occurring in consequence of injuries, abscess, or operations, by which the parotid duct has been opened so as to cause a trickling of saliva through the external aperture that has been made into it. If the fistulous opening be recent, the lips of the external wound may be brought together and made to close, whilst the internal aperture is free. If it be of old date, a seton composed of a few threads may be passed into the fistula from the inside of the mouth, so as to allow the saliva to find its way along this, whilst union of the external orifice is attained by paring its edges and bringing it together with hare-lip pins. My colleague, Mr. Marshall, has succeeded in closing an aperture of this kind by restoring the canal by means of a wire heated by galvanism, and then getting the external orifice to contract.

DISEASES OF THE LIPS.

The *lips* frequently require surgical interference. They may be the seat of tumors of various kinds, encysted or erectile, which require extirpation by the knife or ligature. In dealing with these, the surgeon must be guided by the circumstances of the individual case, but he should, if possible, avoid cutting through the whole thickness of the lip, and if compelled to do so, he must act as will be described when we come to speak of cancer of this region. These growths more frequently occur on the lower lip. When *encysted*, they are usually small transparent tumors, with thin walls, containing a glairy straw-colored fluid. These should always be dissected out; mere excision of a portion of the wall being followed by recurrence of the disease.

Erectile tumors of the lip are usually of an active character, and may either be excised, if of moderate extent and implicating the whole thickness of the lip; or if of large size and projecting from the mucous surface, they may be safely ligatured. I have had under my care some cases of nevus of the upper lip, implicating the whole substance of the part, and have successfully removed them by the repeated application of the potassa cum calce.

Hypertrophy to a great extent occasionally occurs in this situation. This is often of an œdematous character, being kept up by the irritation of fissures or cracks; if so, these must be cured, when the size of the lip will gradually diminish again. Sometimes, however, it becomes permanent, continuing after the cure of the fissure; under these circumstances it may be necessary to excise a portion of the lip, and then to bring the edges together by means of sutures or pins.

Congenital malformation of the lips is of common occurrence. Contraction or even complete closure of the orifice of the mouth has been met with at

birth; such a condition must be remedied according to circumstances by the skill of the surgeon.

By far the most common malformation in this situation, is the condition termed *hare-lip*. This consists of a perpendicular fissure through the upper lip. A similar condition has been described in the lower lip, but I have never seen such a case, or met with anybody who has. In hare-lip, the cleft is usually on one side only; and then it is said to be *single*, and most frequently, so far as I have observed, occurs upon the left side. Not unfrequently there is a fissure on both sides of the mesial line; and then the hare-lip is said to be *double*. The cleft never passes through the mesial line. When double, the fissure is deeper on one side than the other, and usually extends into the nostril, though sometimes it stops short of that. In these cases, the nose is usually flattened and expanded, and between the fissures there is always a central or median lobule, consisting of the inter-maxillary bones in a rudimentary condition; to this a small triangular piece of lip is commonly attached. In many cases this is pushed forwards, and tilted on its base, so that the alveolar border projects forwards. Sometimes the projection is so considerable that it is attached to the tip of the nose.

The cleft in hare-lip corresponds to the line of junction between the embryonic inter-maxillary bones and the superior maxilla. The fissure when single, may be confined to the lip, but in the majority of cases it extends to the upper jaw. In other cases again, the fissure extends back into the palate; this more frequently happens when the hare-lip is double, and in these cases every variety of palatal deformity is met with.

The *cure of hare-lip* can only be effected by a properly conducted operation. In the performance of this, the first point that has to be determined is the age at which it should be done. On this there has been, and is still, a good deal of difference of opinion. Surgeons generally are, however, I think, agreed that the operation should not be performed during dentition; at all events not during the cutting of the incisor teeth, when there is much local excitement and general irritability of the nervous system; but they are not agreed as to whether it should be done before or after dentition. In support of the opinion that it is more prudent to wait until after this period, it is alleged that very young infants are especially liable to convulsions; that the performance of operations in them is troublesome; and that it interferes with suckling. These statements, however, are not carried out by what we meet with in practice. I think that there is no evidence to show that there is any danger in operating during early infancy; indeed, I believe that very young children, those but a few weeks or months old, bear operations remarkably well. I have repeatedly operated at these tender ages, not only for hare-lip, but for hernia, the removal of tumors, nevi, the division of tendons, &c., and have never seen any bad result follow. Besides this, the performance of the operation is easier at a very early age than when the child has reached its first or second year; when its intelligence being more developed, it knows what it has to suffer, and screams and struggles more than a very young infant does, whenever it sees the surgeon, or he makes an attempt to examine the wound or dressings. After the operation, also, the child will, when young, take to the breast without difficulty and with the greatest avidity. The act of suction is advantageous, as in it the sides of the incision are more closely compressed and brought together. At very early ages union of the wound takes place with great readiness and solidity, and as no time has been given for the rest of the features to become distorted, there will not be that permanent flattening and deformity of the face which is apt to continue after the hare-lip is cured if the operation be deferred to a more advanced age. For these various reasons I agree with Dubois and Fergusson, that the operation had best be performed early, and, if possible, at

about the sixth week after birth, or from that to the third month, which may, I think, be considered the time of election for this procedure.

In the treatment of hare-lip, there are three points that require special attention:

1st. To procure union by the direct adhesion of the cut edges of the fissure; 2d. That the union should be attended by as little deformity as possible; and 3d The avoidance of all traction on the line of incision that may interfere with these results.

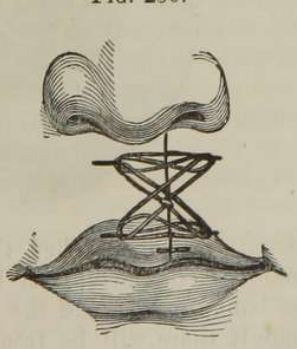
These principles of treatment are carried out by paring the edges of the fissure freely, bringing them together by means of the twisted or interrupted suture, and taking off all tension by means of strips of plaster and the cheek-compressor. But the details of the treatment vary so much, according as the fissure is single or double or complicated by more or less projection of the inner-maxillary portions, that the steps of each operation require to be separately described.

The operation for single hare-lip is performed in the following way: — The child having been well pinned in a jack-towel that swathes it tightly, the surgeon, sitting down, places his feet on a stool so as to raise them, and covering his knees with a piece of tarpaulin, holds the child's head firmly between them. He then, putting the lip on the stretch by seizing the extreme edge of the cleft with a pair of artery forceps, pares the edges of the cleft by transfixion with a narrow-bladed bistoury, or fine scalpel, from above, downwards, first on one side, then on the other, taking care that the incisions unite neatly and cleanly above the upper angle of the fissure, which must be well cut out; and that they extend sufficiently far outwards to cut away the rounded portion of the prolabium which forms the side of the base of the fissure. Care should be taken that enough is cut away; there is more danger usually of taking too little than too much.

In single hare-lip, where the lips are very lax, the incisions may be straight, but in double hare-lip they should be somewhat concave inwards; in this way there is less likelihood of an unseemly notch being left (fig. 260).

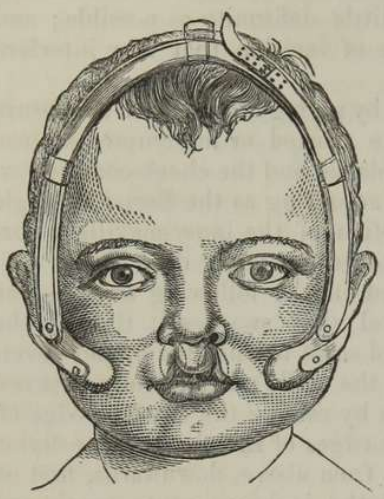
Fine hare-lip pins, made of soft iron wire, with steel points, should then be deeply introduced through the lip from one side of the fissure to the other. At a very early age one pin may be sufficient; at a later period two are required. If two are used, the lower pin should be introduced first underneath, or through the cut labial artery, in such a way that its pressure may stop the bleeding from this vessel, which is often rather free. In passing this pin, great care should be taken to bring the opposite sides of the fissure well in contact, so as to be on a level below, that no irregularity may be left in the prolabium; the twisted suture is then applied in the usual way, first round the lower pin, and then round the upper one, and lastly the two are united by a few cross turns (fig. 259). The pins are then cut short, and a piece of plaster put under their ends to prevent excoriation of the skin. In addition to the pins and twisted suture, I invariably introduce one point of interrupted suture through the mucous membrane of the lower part of the fissure, just inside the mouth; and I look upon this as of great consequence in order to prevent the notching, which is otherwise very apt to occur, in consequence of that portion of the incision between the lower pin and the edge of the lip being kept open by the child in suckling, or protruding its tongue against it. At the end of about the third or fourth day, the pin may be removed by pushing it through the lip by a gentle rotatory movement, in such a way that the cut end does not tear or lacerate the aperture in the lip. The sutures may be left on for two or three days longer; the lip being supported by a strip

Fig. 259.



of adhesive plaster, or by a piece of lint soaked in collodion, which I have found to form a firmer and more secure support than the plaster, and should indeed be continued for about a fortnight after the operation, so as to prevent stretching of the cicatrix and notching of its lower part. The point of interrupted suture may be left in for about six days. If the fissure be wide, and child restless, so that there is danger of the parts being dragged upon during its screaming or crying, it is a very good plan to apply the spring cheek-compressor, invented by Mr. Hainsby, here represented slack (fig. 260).

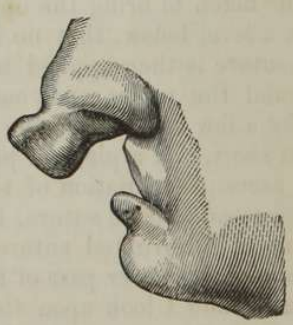
Fig. 260.



The operation for double hare-lip is performed on the same principles as that for the single form of the disease, viz., of procuring union by adhesion between the opposite surfaces. The difference in the operations consists in dealing with the intermediate portion of the lip and alveolus. If this portion of the lip be small or fixed to the tip of the nose, as in fig. 262, it should be cut off, as it would prevent the lateral segments coming into proper apposition; but if large, it should be well pared on either side, and transfixed by the hare-lip pins, and thus be interposed between and united to the pared lateral surfaces; indeed, it is always advisable not to remove this, unless it be awkwardly situated, as in fig. 261, when left, though the union may not appear quite so perfect and uniform as it would if the lateral halves had been directly united, yet eventually the case will turn out better; the central portion becoming developed, and forming the natural mesial projection of the lip, which is lost when the lateral halves are directly united. In some of these cases great nicety is required in planning the incisions, and in the introduction of the sutures. The central portion is most advantageously pared in a somewhat concave manner, so that the freshly cut edges of the lateral halves are received into and more accurately

Fig. 261.

Fig. 262.



fitted upon it. When the intermediate alveolus is small and rudimentary, and more particularly, if it be very prominent, it had better be cut off with a pair of bone-nippers, and the lip brought together over the cut surface. Most commonly there will be free bleeding from the dental artery deep in the bone, and which requires to be touched with a red-hot needle or wire before the hemorrhage from it will cease. Whenever practicable, however, this central portion should be saved, as by its removal not only are the incisor teeth sacrificed, but

a gap is left which causes some deformity in after-life. If the intermediate portion be large and not projecting, it should be left, and the edges of the lip brought together over it. If it be projecting and large, it should be bent forcibly back; this is best done by seizing it with a pair of necrosis forceps covered with wash-leather. If, by any chance, union by the first intention fail, the lip tearing open, the granulating surfaces must be brought in contact with one another again, when they will in all probability cohere as readily as they would have done in the first instance.

Treatment by Simple Suture.—During the last few years I have been in the habit of treating hare-lip of all kinds, double as well as single, with the simple interrupted suture alone, without using any pins. I have in this way treated most successfully many cases in children, whose ages have varied from a few days to four years, with most satisfactory results, and with less marking of the lip than I have ever seen attend union by means of the twisted suture, to which I now generally prefer it as being equally safe, more simple, and followed by less scarring of the lip.

When the fissure is single, the edges, having been pared in the usual way, should be brought together by two points of suture, the first passed deeply near the free edge, and in such a way as to compress the cut coronary artery; the other nearer the nasal angle. These sutures should be of thick well-waxed dentist's twist, that will not cut out too readily. A point of fine interrupted suture should then be inserted through the mucous membrane inside the lip. The lip may then be supported by two narrow strips of plaster, one placed between the sutures, the other between the upper suture and the nose. On the third day the upper suture should be taken out, but the lower one may be left in for a day or two longer, when it and the one through the mucous membrane may be removed together, unless the latter has already cut its way out. The lip must then be supported for a few days with a strip of plaster.

In the case of double hare-lip the same plan is to be adopted, first on one side, then on the other; but in these cases, as the gaps are wider, and the tension, more particularly when the intermaxillary prominence is very projecting, is apt to be considerable, it is necessary to support the cheeks, and thus to prevent undue traction on the stitches, by means of the cheek-compressor. In this way all risk of the stitches cutting out before union is completed is avoided, and excellent and solid union will speedily be obtained even in the worst cases of double hare-lip, with great intermaxillary projection and fissured palate.

Ulceration is not unfrequently met with on the prolabium, frequently of a simple character, though chronic, when it will commonly yield to the application of nitrate of silver and to proper constitutional treatment, more especially the administration of the preparations of arsenic. Not unfrequently warty growths and various forms of epithelial cancer and cancroid diseases appear upon the lips. These affections are not removable by therapeutic means, and require surgical interference.

Cancroid ulcers of the lip either commence as warty growths, which gradually ulcerate like the ordinary forms of tubercular lupus, or beginning as a crack or fissure become indurated, the edges having a tendency to spread, the submaxillary glands to become involved, and the disease eventually to prove fatal by the pain, exhaustion, and constitutional irritation induced by them. These ulcers almost invariably occur in men, affect the lower lip, and are met with after the middle period of life. Of 14 cases in which I have operated, 7 were above sixty, and 4 between fifty and sixty years of age; in one case only did the disease occur under thirty. This disease is at first entirely local, often being induced by some irritation, as by a rugged, broken tooth, or by smoking a clay pipe, and when removed does not, I believe, very commonly return. At least, of the very many cases that have been operated upon at the University

College Hospital, I have only known one patient return with a recurrence of the disease, and I do not recollect any case of secondary affection of this description apply to that institution from other hospitals; I cannot, therefore, but come to the conclusion that the operation for cancer of the lip frequently rids the patient permanently of disease.

When the glands under the jaw are enlarged in these cases, it may be a question whether the operation should be done; but I think decidedly that extirpation of the disease and removal of the enlarged glands, provided the surrounding soft parts are not involved, should be practised, if the patient be otherwise in a good state of health, as he will thus be placed in a more favorable condition than he was before the operation, and will have a better chance of prolongation of life.

When once the true nature of the disease has been ascertained, the operation should be performed with as little delay as possible; but before it is done, it is well that any very prominent or broken tooth should be removed, and the tartar cleared away from the incisors. The operation requires to be somewhat modified according to the situation and extent of the affection; if this be tolerably limited, a V shaped cut, extending widely around it, and carried sufficiently low to include any indurated prolongation of the absorbents, should be practised; the edges of the cut should then be brought together by two hare-lip pins with a twisted suture, just as in the case of a simple hare-lip. When the disease occupies a considerable longitudinal extent, but does not dip down very deeply, a slice of the lip should be shaved off, including the whole of the morbid structure; and it is often surprising, under these circumstances, how little deformity will result, so soon as the disease is removed, the tissues of the lip speedily rising to their natural level, and thus preventing any material deformity being left. In some cases the disease occupies a square surface, and then it is necessary to excise a large portion of the lip; when this is done, a considerable gap will be left, which requires to be filled by some plastic operation, such as we shall immediately consider, which may most conveniently be done at the time that the excision is practised.

PLASTIC SURGERY OF THE FACE.

By *plastic* or *reparative surgery* is meant those processes by which mutilations are repaired, and loss of structure replaced. As these operations are principally practised for deformities of the face, we may conveniently discuss them here. It has been long known to surgeons that parts of the body may retain their vitality sufficiently to become again adherent when attached but by a very narrow tongue of tissue, to the part from which they have been all but separated. This has often been observed in cases of injuries of the face and fingers, portions of which have been nearly completely severed, and yet have united again on being replaced. But there are even a sufficient number of cases on record to show that certain parts, when completely separated, may, after being replaced, again become adherent. The most remarkable instances of this kind are those related by Dr. Hoffacher, and which are attested by Chelius and Velpeau. Dr. Hoffacher was officially appointed to attend as surgeon at the duels which were at one time frequent amongst the students at Heidelberg, and, as at these encounters broad-swords were used, he had an opportunity of seeing a considerable number of incised wounds, and has related no less than 16 cases in which portions of the nose, lips, or chin, had been sliced off, and being put on again, contracted adhesions. Amongst the most remarkable of these, is a case in which the end of the nose was sliced off by a cut with the broad-sword, and fell under a chest of drawers; it was not found for some time, but on being recovered and washed, was stitched on, when it became firmly attached. In another instance, a dog that was in the room

snapped up the detached portion of the organ as it fell to the ground, but the nose being immediately taken out of the animal's mouth and put on again, became firmly fixed!

In order that union should take place between parts that have been separated completely or nearly so, and the rest of the body, it is necessary that they be soft and vascular, and more especially that their structure be of a homogeneous character, such as is met with in the tissues of the face; where no very large blood-vessels, nerves, tendons, or bone are found. It is the same in plastic operations, which succeed best under similar conditions of tissue, and which are conducted on the same principle as an attempt at union in a partially severed structure.

Union in plastic operations is effected by primary adhesion between the flap of skin that is partially detached, and the raw surface on which it is laid and attached. Should, however, this mode of union fail from any accidental circumstance, the surgeon need not despair, as the parts may unite by adhesive inflammation or even through the medium of granulation in a very satisfactory and complete manner.

For proper union to be effected it is necessary that the edges be cleanly and evenly cut, so as to adjust themselves accurately to one another. This may often be most skilfully effected by making the incision in the part that is to receive the flap somewhat oblique or bevelled, thus securing a more accurate adaptation of the edges.

After the flap has been formed and the part in which it is to be transplanted properly pared, the operation should be delayed a few minutes until all bleeding has ceased. This is of much importance, as the interposition of a layer of coagulated blood will materially interfere with union.

In bringing the parts into apposition great care must be taken that no undue traction or constriction be exercised, lest their circulation be interfered with, and their vitality be endangered.

The parts may be maintained in apposition by sutures, collodion, or the application of a strip of isinglass plaster. The sutures should be as fine as possible, introduced with a small needle, and knotted on the sound parts. Occasionally fine hare-lip pins may advantageously be used. In some instances instead of sutures a small spring forceps (fig. 52), termed a "serrefine," may be employed, but most generally interrupted sutures are the best. The use of collodion is of great advantage in plastic surgery, as it not only secures adhesion, but by excluding the air lessens the chance of suppuration.

For a plastic procedure to succeed, it is absolutely necessary that no morbid action be going on in the seat of operation, and not only that none be actually in progress but that all have ceased for some considerable time. This is more particularly the case when the deformity for the remedying of which it is practised has resulted from syphilitic or cancerous ulceration. In both cases it is necessary to see that the constitution is sound as well as that all local disease has been eradicated; otherwise the irritation of the operation might set it up again and the new flap be invaded and destroyed. From want of this precaution I have more than once seen disappointment result. As a general rule, plastic operations practised for the repair of mutilations from injury are more successful than those that are had recourse to after disease.

The patient's general health must be in a sound state lest the adhesive action, on which the success of the operation is dependent, be interfered with. No routine system of treatment should be adopted, but a few days of rest, good diet, and a dose or two of aperient medicine, may be prescribed before the operation is proceeded with. In the after-treatment of the case a nourishing but unstimulating regimen should be observed.

In performing these various plastic operations three methods have been employed. In the first, the flap of skin that is intended to repair the lost

structure is transplanted from a distant part, as the arm for instance. This operation, which was introduced by the Italian surgeon, Tagliacotius, and hence commonly called by his name, has in a great measure fallen into disuse, on account of the difficulty of its execution, and the great uncertainty of obtaining a successful result. The second plan consists in transplanting the reparative structure from some part in the neighborhood of the organ to be repaired; the skin from the forehead, for instance, being used for the formation of a new nose; that from the chin for the restoration of the lost lip. This procedure, which seems first to have been adopted by the natives of India in restoring the loss of the nose, is the method that is most commonly employed in this country in plastic operations on the face. The third method consists in loosening the skin by a process of subcutaneous section to some distance around the part to be repaired, and then drawing it forwards with or without incision through its substance. This gliding operation is chiefly practised for the closure of fistulous openings.

It is principally for deformities and loss of the nose and lip that plastic operations are of much service; they may, however, occasionally be had recourse to in other situations, as about the cheeks and eyelids, but seldom with an equal amount of success. In the practice of this very interesting branch of surgery there is much opportunity for the display of manual dexterity, on which, indeed, almost the whole success of the operation depends, and a vast deal may be done in apparently the most unpromising cases by management, skill, and patience. In these operative procedures the names of Serres, Dieffenbach, Liston, and Jobert, deservedly take the first rank.

The only plastic procedures the performance of which can be reduced to distinct rules, are those for the restoration of a lost nose, *rhinoplastic*, and for partial loss of a lip, *cheiloplastic*. As these operations are commonly practised for loss of the part from cancroid, strumous, or syphilitic disease, especial care must be taken before they are commenced, that all morbid action has entirely ceased for at least a year or two, lest the irritation of the operation set it up again, and thus the new flap be invaded and destroyed; I have more than once seen much disappointment ensue from want of attention in this respect.

When the operation is performed for cancroid disease, ablation of the morbid part may be done at the moment of operating — the affection being a local one; when for struma or syphilis, the disease is constitutional, and care must be taken that all morbid action has thoroughly and completely ceased.

RHINOPLASTIC OPERATIONS.

Restoration of Columna. — When the columna and a portion of the septum are destroyed, a large gap is left at the nasal aperture, and the nose becoming flattened in consequence of its tip falling in, great deformity necessarily results. The upper lip also losing that amount of support which it receives from the columna, becomes pendulous, projecting, and thickened at the end, thus adding to the disfigurement. The restoration of the columna is effected from this thickened and prominent upper lip, which, by being reduced in size, is rendered far more shapely. The operation consists in cutting through the whole length of the lip from above downwards on either side of the mesial line so as to leave a tongue about one-third of an inch in width. This is then turned up, and its end being well pared, and the under surface of the tip of the nose properly vivified, it is fixed there by means of a fine hare-lip pin and twisted suture, which should be left in for about four days. Union takes place in a few days, but until this is firm the new columna must be properly supported with narrow strips of plaster fixed to the cheeks on either side. No twisting of this small flap is required, as the mucous surface speedily becomes cutaneous, and *vice versâ*. The division in the upper lip must be treated in the same way as an

ordinary hare-lip, and unites without difficulty, lessening greatly the deformity in this part.

Restoration of Ala. — When one ala only is deficient, the rest of the nose being sound, a flap of skin of the proper shape to restore the deformity may be raised from the cheek and applied to the edges of the part requiring it, previously pared, and fixed there by a few points of fine suture. If the loss of the substance of the ala be very considerable, or if it extend to a part of the body of the nose, then it is more efficiently restored by bringing a long narrow flap from the forehead in the way that will immediately be described. In the majority of cases the destruction of the ala and of the body of the nose is so considerable, that other plans than those just described are required for the repair of the deformity. The methods that may be had recourse to are the Tagliacotian and the Indian operations. Occasionally fistulous openings are met with through the nasal bones leading into the interior of the nostrils. Such apertures as these are, perhaps, best closed by paring the edges and then bringing forward a flap of neighboring skin by the gliding operation.

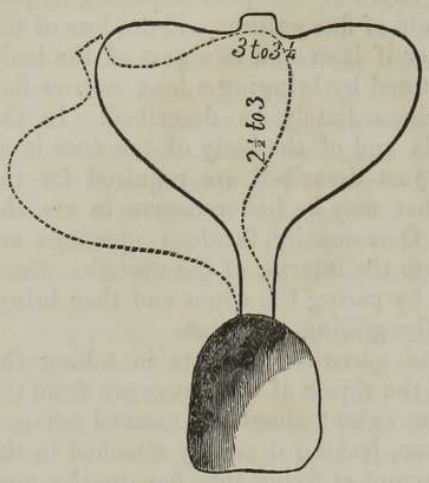
Restoration of Nose. — The *Tagliacotian operation* consists in taking the integument and cellular tissue required for the repair of the lost organ from the inside of the arm. Here a flap of sufficient extent should be marked out and dissected up with its subjacent cellular tissue, leaving it merely attached to the limb by a root at its distal end. No attempt at fixing this flap to the nose should be made for at least a fortnight, during which time it should be kept upon a piece of wet lint, and allowed to thicken, granulate, and become vascular, so as to fit itself for adhesion to the new surface to which it is to be applied. The remains of the deformed nose having then been properly pared and the flap shaped, they must, after all bleeding has ceased, be properly adjusted and fixed to one another by points of suture. The arm must then be closely attached to the head so as to be as nearly as possible immovable. At the end of about ten days when adhesions have taken place, the connecting medium may be cut across and the part left to be supported by the vitality that it may gain from the new surface to which it is now attached. This process is comparatively seldom had recourse to, for obvious reasons. The uncertainty of maintaining the vitality in the flap, the extreme tediousness of the prolonged constrained position in which it is necessary to keep the patient, and the great difficulty of guarding against movements of the arm, especially during sleep, and which, however slight and involuntary, would be sufficient to disturb union between the opposed surfaces and occasion the failure of the operation, have caused this plan of procedure to fall into disuse; and it is now, I believe, universally abandoned by surgeons in this country, having been replaced by the more certain procedure of borrowing the skin for the new nose from the forehead.

This, *the Indian operation*, a knowledge of which was brought to this country by Mr. Carpue, in 1814, is extremely successful in its results, though requiring a good deal of nicety for its proper execution. The operative procedures required by this method are somewhat complex, and may conveniently be divided into three distinct periods; the 1st consisting in the dissection of the flap from the forehead, and its attachment to its new situation; the 2d, the separation of the root of the flap where it is turned down from the forehead, and the formation of a proper bridge to the nose; and the 3d, the formation of the columna nasi.

1st. In the shaping of the flap, care must be taken that it is of sufficient size, as during the after part of the treatment, it often has a tendency to shrivel, and more inconvenience usually results from its not having originally been made large enough than the reverse. The size adapted to the particular face may best be judged of by moulding a thin piece of gutta percha to the nose, then flattening it out by dipping it in hot water, and using this as the guide

for marking the outline of the flap upon the forehead. This should be traced with tincture of iodine, which will not wash off so readily as ink by the flow of blood, which is often rather free. This flap should be of the shape in fig. 263, taking care that it is rather square at the angles, and not too much rounded off. The size will necessarily vary according to the character of the countenance, and the extent of loss that has to be repaired. When the whole of the nose requires restoration, it is usually necessary to make it about two and a half to three inches in length, by about the same in width at the broadest part. It may either be taken from the middle of the forehead, or obliquely from one side. If the latter, the right side is the most convenient. It must now be dissected off the forehead; in doing this care must be taken not to remove the pericranium, but at the same time to cut the flap as thick as possible, especially at its root between the eyebrows. It must also be but little handled, and, above all, not pinched, either with fingers or forceps. The dissection should be commenced at the root, so that the outline may not be obscured by blood; and this part should be left long, in order to admit afterwards of a very gradual and easy twist. In order to facilitate this, it is also desirable to make the incision on the right side a little lower than that on the left. After the flap has been raised throughout the whole of its extent, a piece of wet lint should be applied to the forehead, with a view of arresting the bleeding, before the next step is taken. This consists in paring the surface and edges of the stump of the nose, and removing the integuments from it in such a way as to leave a triangular raw surface. In doing this care must be taken, whilst a good base of attachment is left, not to remove the parts too widely, lest the cheeks, by separating, have a tendency to gape too much, and the nose to become flattened out. The integuments also should be dissected away in such a manner as to form a deep groove shelving inwards, so as to receive and hold the flap more securely and with less overlapping of the edges. The operation must now be discontinued for a few minutes until all bleeding has ceased, and the cut surfaces have become glazed; this point is of great importance in securing direct adhesion, and must be carefully attended to. The bleeding having been arrested by exposure to the air, and by the torsion rather than the ligature of any spouting branch, the flap from the forehead should be brought down by a twist from left to right, and attached by a few points of fine suture on either side to the edge of the incision around the nasal aperture. A pledget of soft lint, moderately greased, should now be gently insinuated under the flap, the lower part of the incision in the forehead drawn together by a point of suture, but not so as to constrict the root in any way, and the rest of the exposed surface covered with water-dressing. The parts will then present the appearance of fig. 265, taken from a patient of mine the day after the operation. Fig. 264 represents the deformity for which the operation was performed. The patient should be put to bed with a piece of soft lint laid over the whole of the face, so as to maintain its temperature, and if it be winter, placed in a room that is kept well warmed day and night. The diet for the first few days should be simple, but abundant, consisting chiefly of nutritious slops.

Fig. 263.



The dressings must not be disturbed for three days; by this time, if all goes well, the flap will be found somewhat tumid, warm, and sensitive, but pale in

color. The plug in the nose will now require changing, lest it be rendered offensive by the discharges; its withdrawal and the substitution of another

Fig. 264.

Fig. 265.

must be done with the greatest gentleness, the surgeon bearing in mind that any undue pressure or traction may destroy adhesions and prove fatal to the vitality of the flap. If the sutures produce no irritation, they may be left in till the fifth or sixth day, by which time the adhesions will be tolerably perfect, and they may with safety be cut and withdrawn. As the adhesions strengthen and the vitality of the flap improves, it must be elevated by putting underneath it a larger plug of lint, for which, after a time may be substituted a small gutta-percha tube moulded to the figure of the inside of the nose. Œdema of a somewhat solid character is apt to come on in the flap, giving it a white appearance, but this is of little moment, and will gradually subside as the circulation through it becomes more actively established. The flap gradually becomes thicker and firmer, throwing out granulations from its under surface, which eventually becomes clothed with mucous membrane. The wound in the forehead must be dressed like an ordinary ulcer, and be well touched with nitrate of silver from time to time, to insure its contraction. It usually cicatrizes with great readiness, and leaves remarkably little deformity.

2d. The next step in the operation is the division of the root of the flap, which may be done about a month after it has been fashioned, when its vascularity, through its lateral adhesions, will be perfected; the division of the root is best done by passing a narrow-bladed bistoury under the twist, and cutting upwards towards the eyebrows, removing a wedge-shaped portion of the soft parts so as to make a smooth and proper bridge.

3d. The addition of the columna is now all that is wanted to make the nose complete. This must be made from the upper lip at the same time perhaps that the bridge is fashioned, and may be cut and fixed in the way that has been already described in speaking of the restoration of this feature, the interior of the apex of the new nose having been well pared to receive it. The columna requires to be well supported by means of a narrow strip of plaster passing from one cheek to the other, and usually requires a good deal of fashioning before it is perfect; indeed this is the part of the operation that I have found always most troublesome, and requiring most attention. The new nose must be continued to be supported from beneath, for some months after its formation, by plugs of lint, or small gutta-percha tubes, as it will evince a great tendency to contract and to alter in its general outline and shape, becoming, if the surgeon

is not careful, either depressed or dumpy. The sensibility of the new nose is entirely destroyed for a time after the division of the bridge, but it slowly returns from all sides, appearing first in the neighborhood of the adhesions between it and the cheeks, then near the columna, next in the bridge, and thus

Fig. 266.

Fig. 267.

the organ at last has its sensations restored; for this, however, several months will usually be required, and the part in which it returns last of all is its central portion. The annexed cuts give a very faithful representation of a patient on whom I operated, before and after the restoration of the lost organ (figs. 266 and 267).

The success of the case will depend very greatly upon the minute attention that the surgeon bestows on the details of the operation, and on the care that he takes in the after-treatment. During the operation the chief points to be attended to are, that the flap is made of sufficient size, and that all oozing has ceased before the cut edges are brought into contact, and that no tension or constriction be exercised. The principal causes of failure in the operation or in the result, so far as concerns the after-appearance of the patient, are in consequence of gangrene of the flap, in whole or in part, taking place from the root being too narrow, too tightly twisted, or the flap too roughly handled in its dissection. So also if it be cut too small and not properly supported afterwards, the result will not be very satisfactory. Other accidents occasionally happen; thus erysipelas may occur, destroying at once the vitality of the flap, or, coming on at a later period, when the new nose will slough under the attack of inflammation, which it has not sufficient vitality to resist, as happened in one of Mr. Liston's earlier cases; or it may be destroyed by a return of the lupus which proved destructive to the old one. Hemorrhage may also occur from underneath the flap. In the last case operated on by Mr. Liston before his death, and which was completed by Mr. Morton at University College Hospital, hemorrhage to the extent of more than a pint took place on the ninth day without any evident cause, from under the flap, and could only be arrested by plugging. Lastly, the operation is not without its dangers. Dieffenbach lost two patients out of six on whom he operated in Paris; their constitutions, probably, being in an unfavorable state.

When the nose is depressed and flattened, in consequence of the loss of the cartilages, vomer, and septum, though the external parts remain entire, Dieffenbach has proposed a plan for raising it, by slitting it longitudinally

into three pieces; dissecting the lateral slips from the osseous attachments, then paring the edges to such an extent that they overlap, and stitching them together, to bring the whole organ forwards by pushing long hare-lip pins across its base, so as to elevate and narrow its attachments, which are brought more into the mesial line. Fergusson has improved this procedure by not slitting the nose down, but by dissecting it away from the bones from within the nostril, and then pushing long steel-pointed silver needles across from cheek to cheek, and twisting their ends over perforated pieces of sole leather, through which they had previously been passed, thus bringing the whole organ bodily forwards. The columna is next fashioned in the way that has already been described, and the nose thus completed.

CHEILOPLASTIC OPERATIONS.

The restoration of a portion of the lip, that has been lost by accident or disease, is not so readily effected as that of the nose, but yet, a good deal may be done to restore the deformity. The plan originally introduced by Chopart consists, when it is the lower lip that is deformed, in carrying an incision from behind the lower jaw, down to the os hyoides, so that a square flap may result, which is detached from above downwards. This flap is then brought up and fixed to the pared edges of the remaining portion of the lip by points of suture, the head being kept properly inclined, in order to prevent undue tension. After sufficient union has taken place to preserve the vitality of the flap, its lower attachment may be divided. The flap should, if possible, not be twisted, though it is not always practicable to avoid this. This operation is not usually very satisfactory in its results, as the new flap is apt to become œdematous and inverted at the edge, or the flow of saliva may interfere with proper union. In those cases in which the greater portion of the lower lip has been excised for cancerous disease affecting its upper margin, the most successful procedure for the restoration of the deformity, consists in a modification of the plan recommended by Serres, and from this I have derived excellent results, as in the case which is here represented (fig. 268). The object of the operation is to raise the lower lip on a level with the incisor teeth. This is effected in the following manner: an incision, about three quarters of an inch in length, is made directly outwards from the angle of the mouth, on either side, into the cheek; from the extremity of this, a cut is carried obliquely downwards on to the upper margin of the lower lip, so as to excise the included triangular piece; the lower lip is then dissected away from the jaw, from the inside of the mouth, and a V shaped piece taken out of its centre. By means of a hare-lip pin on either side, and a point of suture, the incisions in the angle of the mouth are brought accurately together, and in the same way the vertical one, in the centre, united (fig. 269). In this way the whole of the lower lip is raised, and brought more forwards. If care has been taken, in removing the cancer from the edge of the lip, to leave the mucous membrane rather long, which may always be done, as the skin is affected to a greater extent than it, a good prolabium may be formed, and the restoration effected with but little deformity. Care must be

Fig. 268.

taken to prevent union occurring between the inside of the lower lip and jaw by the interposition of a strip of oiled lint.

Mr. Syme has introduced an operation by which the cancerous ulcer of the lower lip having been removed in a triangular form, by two incisions extending from the angles of the mouth to the chin, the cuts are carried obliquely downwards and outwards, on each side, under the body of the jaw, and made to terminate in a slight curve outwards and upwards (fig. 270). The flaps thus

Fig. 269.

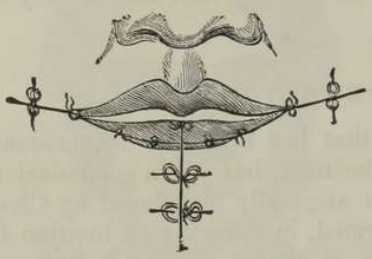
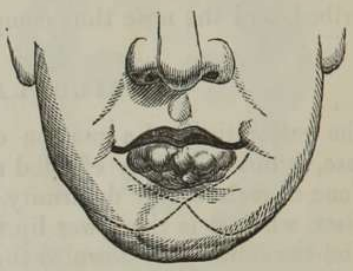


Fig. 270.



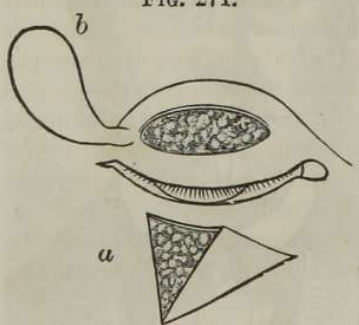
formed are detached from their subjacent connections, and the whole raised upwards, so that the original triangular incision comes into a horizontal line, and is made to constitute the margin of the new lip; the secondary incisions under the jaw coming together in a vertical direction, in which they are retained by twisted and interrupted sutures.

BLEPHAROPLASTIC OPERATIONS.

Blepharoplasty, or the operation by which the eyelids are repaired, is occasionally required for loss of substance,—the result of wounds, cicatrices, or operations. It is less satisfactory in its results than most of the other plastic procedures about the face; but yet may, in some cases, improve materially the patient's appearance.

When the upper eyelid requires repair, the flap is taken from the forehead; when it is the lower lid, from the cheek or temple. This operation may be performed either by the gliding method, or by twisting a flap into its new situation. When by the gliding method, a triangular flap is cut and partially detached (fig. 271 *a*), and then drawn gently forwards until it corresponds to and fills up the gap that requires repair, when it is there fixed by a few points of suture. When the twisting method is employed, an oval flap is detached (fig. 271 *b*), except its pedicle, and twisted down, to be planted on the raw surface.

Fig. 271.



Occasionally neither of these methods (fig. 272) is applicable, and then the procedure, that was successfully adopted in a case of which the annexed cut is a representation, may be adopted. Here there was a deep and hard cicatrix across the lower eyelid, causing eversion of its outer portion, and adhesion of the inner part to the ball of the eye. After dividing the adhesions and removing the cicatrix, I made a semilunar incision so as to dissect up the eyelid, and then fixed it by points of suture in its new situation, where it became firmly adherent (fig. 273).

Operations of various kinds are frequently performed on the eyelids that are truly of a plastic character.

Thus in *Symblepharon*, or adhesion between the lid and the eye-ball, the adherent portion of lid may be included between V shaped incisions removed and the edges of the cuts brought together (fig. 274 *a*).

Fig. 272.

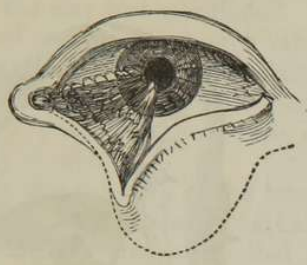
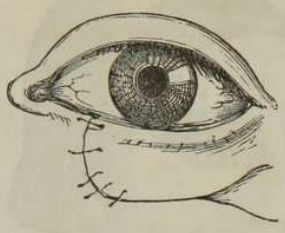
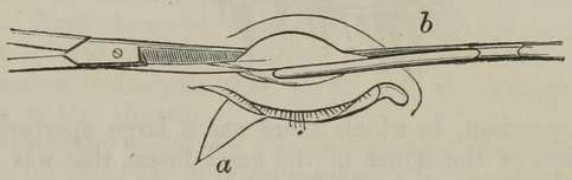


Fig. 273.



In *Epicanthis*, or the projection of the nasal fold of the eyelids, an elliptical portion may be removed parallel to the nose, and the edges of the incision brought together with sutures.

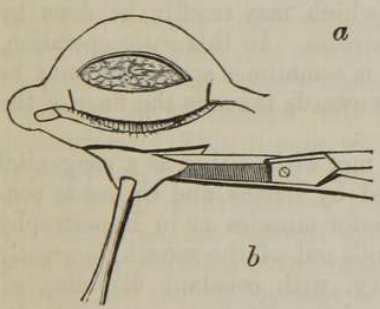
Fig. 274.



In *Ptosis*, or drooping of the upper eyelid, an oval portion of the lid may be raised horizontally, and removed so as to leave an oval gap (fig. 274 *b*), the edges of which being brought together will lessen the depth of the lid, and thus diminish the deformity.

In *Entropium*, or inversion of the eyelid, the same operation may be practised on it, and thus, by the contraction of the cicatrix, the tendency to its turning inwards lessened. But various other procedures are at times required in order to remedy this deformity. Thus a vertical instead of a transverse flap may be removed; or Crampton's plan may be followed, which consists in making a vertical incision through the whole thickness of the lid, near either angle (fig. 275 *a*), and then removing a transverse fold of the skin, bringing the edges of that wound together in the usual way. This operation is chiefly applicable when the tarsal cartilage is contracted and shortened as it were; or lastly, when the tarsal cartilage is much contracted and inverted, the whole edge of the lid may be removed by passing a Beer's spatula between it and the ball, and then cutting upon it.

Fig. 275.



In *Ectropium*, or eversion, the lid may be well everted and a portion of the conjunctiva raised with a pair of forceps and snipped off. This operation seldom succeeds however; and it is usually better to remove a wedge-shaped portion of the lid, of size proportioned to the amount of eversion; or Dieffenbach's method may be tried, which consists in making a transverse incision through the lid down to the conjunctiva, seizing this, drawing it forwards until the lid is restored to its proper shape, then removing the projecting fold and bringing the edges of the incision together in the usual way (fig. 275 *b*).

Besides these more regular plastic operations, various other procedures may be required for the restoration of deformities of the face, in which the surgeon

may display much ingenuity and benefit his patient greatly. The annexed cuts (figs. 276, 277) represent a case lately under my care, before and the day after

Fig. 276.

Fig. 277.

operation, in which there was a large aperture by the side of the nose, with loss of the bones of the nasal fossæ, that was successfully closed by a flap of skin taken from the forehead.

DISEASES OF THE TONGUE.

Infants and even adults are said to be *tongue-tied*, when the frenum linguæ is shorter than usual, causing the end of the tongue to be depressed and fixed, so that it cannot be protruded beyond the incisors. If this malformation be considerable, suckling and distinct articulation may be interfered with, and then division of the fold becomes necessary, which may readily be done by snipping it across with a pair of round-ended scissors. In this little operation, the risk of wounding the ranine arteries that is sometimes spoken of, may be avoided by keeping the point of the scissors downwards towards the floor of the mouth.

Prolapsus of the tongue has occasionally been met with, either as a congenital or an acquired condition; it has been described by Lassus and Crosse as consisting either in a want of power in the retractor muscles or in hypertrophy of that organ. In this condition, the tongue lolls out of the mouth, is greatly swollen, of a purplish color, but somewhat dry, with constant dribbling of saliva. If the swelling have existed for a long time, it may give rise to deformity of the teeth, and of the alveolus of the lower jaw, which is pushed forwards. In the treatment of this affection, little can be done unless it be excessive and of a permanent character, when excision of a portion of the tongue by knife or ligature may be required. In children, the ligature would certainly be the safest, as excision might be followed by abundant hemorrhage, not very easy to arrest.

Glossitis is a rare affection, more particularly when occurring idiopathically; most commonly it results from profuse and injudicious salivation. In this disease the tongue is greatly infiltrated with serum and blood, becoming immensely swollen, so as to hang out of the mouth, with profuse salivation and inability on the part of the patient to swallow or speak, with perhaps a threatening of suffocation. The treatment is as simple as it is efficient; it consists in making

a long and free incision along the dorsum of the tongue on either side of the raphe, which gives free and immediate relief by the escape of the blood and infiltrated fluids. I have seen a patient, who was nearly suffocated by the immense size of his tongue, relieved at once, and get nearly well in the course of a few hours by such incisions. Purgatives, especially of a saline character, are also useful, but these cannot be administered until after the swelling has been relieved in the way just mentioned.

Abscess of the tongue, though rare, occasionally occurs. A boy was brought to me some time ago with an elastic fluctuating tumor of slow growth, and about the size of a small plum, situated deeply in the centre of the tongue; on puncturing it, about half an ounce of healthy pus was let out, after which the cyst speedily closed.

The *epidermic covering* of the tongue may become the seat of various morbid changes; amongst the most remarkable of which is psoriasis. In this affection the tongue is indurated, shrivelled and dry, having cracks upon its surface, with patches of a dead-white color, and irregular shape, varying in size from that of a split-pea to an inch in diameter; this condition exactly resembling psoriasis of the palms of the hands, may occur with or without scaly disease of the general integument. I have seen it in both conditions, and have always found it a most difficult affection to treat. The preparations of arsenic with Plummer's pill and sarsaparilla, have, however, appeared to afford the best results. In some instances, it is evidently of syphilitic origin, and then it requires to be treated on the general principles that guide us in the management of the constitutional forms of that disease.

The surface of the tongue occasionally assumes a glazed and warty character, as if covered with a layer of boiled sago, the mucous membrane being œdematous, elevated, and papillated, but at the same time glassy and semi-transparent, and without induration. This condition, which is usually of syphilitic origin, requires the constitutional treatment for that disease.

Fissures or *cracks* not uncommonly appear upon the side of the tongue, usually opposite the molar teeth, sometimes dependent on irritation of stumps, but not unfrequently on dyspepsia. These cracks may in some depraved states of the constitution extend rapidly, eroding away a considerable portion of the side of the organ in a short time, so as to leave a large and deep sloughy cavity with much dusky inflammation around it, with great fetor of the breath, and a copious discharge of saliva which trickles out of the corners of the mouth; the patient being usually destroyed in from three to six months, by the irritation of the discharges, the inability to take food, and the supervention of hemorrhage. This disease, which is a combination of sloughing and ulceration, is best treated in the early stages by the application of leeches beneath the jaw, and the use of chlorinated gargles, with a moderately antiphlogistic regimen; as it advances, the internal administration of arsenic is useful in some cases, with the application of the balsam of Peru, either pure or diluted with the yelk of egg, and the employment of gargles composed of the chlorides and the tincture of myrrh.

Syphilitic tubercle is not unfrequently met with in the tongue, as one of the advanced symptoms of constitutional syphilis, forming an indurated irregularly circumscribed mass, of a round shape, situated deeply in the substance of the organ, or toward the centre of the tip. The surface covering the tubercle is of a dusky red or coppery color; it rarely runs on to ulceration, though rhagades and fissures occasionally form around it; there is no fetid discharge and no destruction of the organ in these cases. The treatment consists in the administration of small doses of bichloride of mercury in sarsaparilla, under which it will rapidly disappear.

Various cancerous and cancroid diseases may occur in the tongue. These affections usually commence with tubercles, or fissures, or as a solid mass in

the body of the organ; most commonly the disease is situated at the sides, but occasionally the tip is affected. If as a tubercle or warty growth, it is usually flat, indurated, and of a purplish-red color, gradually running into ulceration; if with a fissure, this from the commencement has an indurated base, a foul surface, and an everted edge. As the ulceration extends, a chasm with ragged sides, a sloughy surface that cannot be cleansed, and a widely indurated base, gradually forms; there is great fetor of the breath, profuse salivation, and as the disease progresses, implication of the mucous membrane and of the structures of the floor of the mouth, and of the submaxillary or sublingual glands, takes place. The lymphatic glands under the jaw usually become involved at an early period, but I have known the disease exist for a year or two without their becoming implicated. Cachexy at last supervenes, and the patient dies from the conjoined effects of exhaustion, irritation, and poisoning of the system. In the majority of instances, the disease assumes a cancroid form, but tumors of the tongue may occasionally occur, presenting all the characters of scirrhus. In one instance I have seen cancer of the tongue assume a truly encephaloid character; it was a case in which the disease had twice been removed, and recurring a third time, assumed the character of a large, soft, fungating growth, with rapid implication of the floor of the mouth and maxillary glands, death speedily occurring from exhaustion.

The *diagnosis* of these various forms of disease of the tongue is important. The foul and sloughing ulcer may be distinguished from all others by the rapidity of its progress, its eroding action, and the absence of all induration at its base. Syphilitic ulceration, with an indurated base, commonly closely resembles cancer of the tongue; so closely indeed, that it is only with great difficulty that the diagnosis can be effected. This, however, may generally be accomplished after a time, by observing that the syphilitic ulcer is elongated, irregular, and does not rapidly extend; the cancerous ulcer on the other hand is of a circular shape, has eroded edges, and spreads with considerable rapidity. The influence also of treatment will after a time throw light upon the nature of the disease, and the scrapings of the cancerous ulcer when examined under the microscope, will always reveal its true character.

The diagnosis between the syphilitic and cancerous tubercle is most important; here the duration of the disease and the co-existence of constitutional syphilis must be taken into account. It is also of much moment to attend to the situation of the tumor, the syphilitic tubercle being almost invariably met with deeply in the substance of the organ, whilst the cancerous growth is commonly seated at its edges or tip.

In the *treatment* of cancer of the tongue therapeutic means are utterly useless; and no measures hold out any chance of recovery to the patient except the removal of the diseased structure. This may be effected either by the ligature or the knife, and should be done as early as possible, before glandular or constitutional infection has come on. When the free portion of the tongue only is diseased the morbid structure may readily and safely be excised; any hemorrhage that ensues being arrested by the ligature of the bleeding points, or by the introduction of ice into the mouth. When the organ is more extensively diseased it has been proposed to divide the lower jaw, and thus to get a view of the whole of the tongue, and to remove as much as proper, treating afterwards the section in the bone as a fracture of it. When, however, the tongue is very deeply diseased excision is objectionable, as the hemorrhage that follows may be so considerable as to be stopped with difficulty, and, indeed, to require the application of the actual cautery for its arrest. In these deep cancerous affections of the tongue also, there is usually great enlargement of the submaxillary glands, with infiltration of the floor of the mouth and of the neighboring soft parts to such an extent as to render it impossible with safety or advantage to excise the diseased mass.

The ligature is the plan usually had recourse to, and which, indeed, I think, is in all cases, except where the tip is alone involved, preferable to excision; but though there is no risk of hemorrhage when this means is used, yet it is not without objection on account of the painful nature of the process and its tediousness. Mr. Hilton has removed the first objection by proposing and practising the section of the gustatory nerve prior to the application of the ligatures. This operation may be done by drawing the tongue forwards and dividing the mucous membrane and submucous tissue vertically for three quarters of an inch, opposite the molar teeth, over the hyoglossus muscle, and across the upper portion of the sublingual gland; much venous bleeding usually occurs, which embarrasses the search for the nerve, yet with a little dissection this may be exposed and divided, when sensation will cease in the whole of that portion of the tongue which is anterior to the line of incision. By means of the ligature any portion of the tongue, however deeply seated, may be securely strangled. For the purposes of this operation strong thick saddler's whipcord is the best, as it does not readily cut through the soft and brittle tissue of the organ, as would be the case if the small compressed cord usually sold by the instrument-makers is used.

In removing cancer of the tongue by ligature, the patient should be conveniently seated opposite a strong light. The surgeon then passes a strong silk thread doubled, through the tip of the tongue, by which an assistant draws the organ out of the mouth; a wooden wedge is next placed between the teeth of the upper and lower jaws, on the side opposite to that on which the operation is to be performed, and the ligature is then passed by means of an ordinary nevus needle, or what is often more convenient, a corkscrew needle curved on the side as well as to the point (fig. 278). In many cases the plan described for ligaturing flat nevi will be found the most convenient mode of passing the whipcord round the cancer of the tongue (fig. 279). In whatever way the ligatures are applied, care should always be taken to pass them through the healthy tissue of the organ wide of the disease, and they should then be tied very tightly, so as to strangle the

Fig. 278.

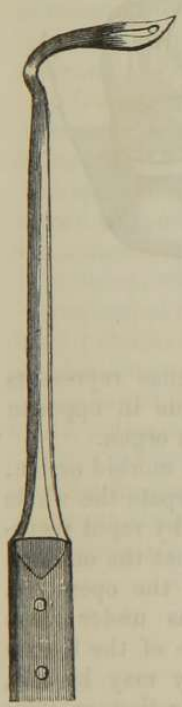
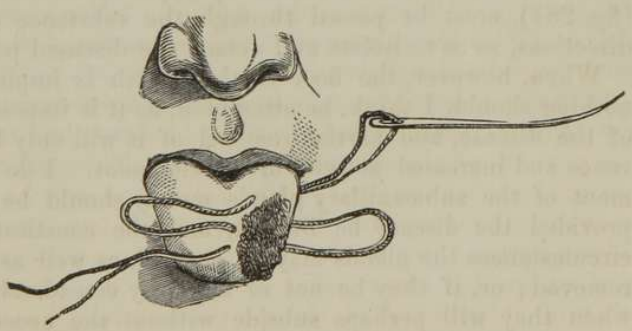


Fig. 279.



mass effectually. Great swelling of the tongue, followed by profuse salivation and some fetor of the breath attend this operation, but the mass, if properly constricted, will slough away in a few days, leaving a large gap that readily fills by granulation. When the disease exists so far back in the tongue that it cannot readily be reached from the mouth, Cloquet, Arnott, and others have successfully strangled it by making an incision in the hyoid region, between the genio-hyoid muscles, forcing the ligatures by means of long needles through the base of the tongue, and then drawing them tight through the aperture in the neck, so as effectually to constrict the diseased mass.

Regnoli has successfully extirpated large portions of the tongue for cancerous disease of the back of the organ, by making an incision of a semi-lunar shape, along the line of the lower jaw from one angle of the bone to the other, thus opening into the cavity of the mouth through its floor, then making a vertical cut through the centre of this, from the os hyoides forwards, clearing the parts by a little dissection, and drawing the tongue through the opening down upon the anterior part of the neck, where the diseased structures may be ligatured or excised (fig. 280). The wound is then closed and united in the usual way. By this means the surgeon can reach portions of the organ that cannot be got at in any other way.

The ecraseur has been successfully used by Chassaignac in removing tumors of the tongue that could not otherwise be extirpated. In such operations two

Fig. 280.

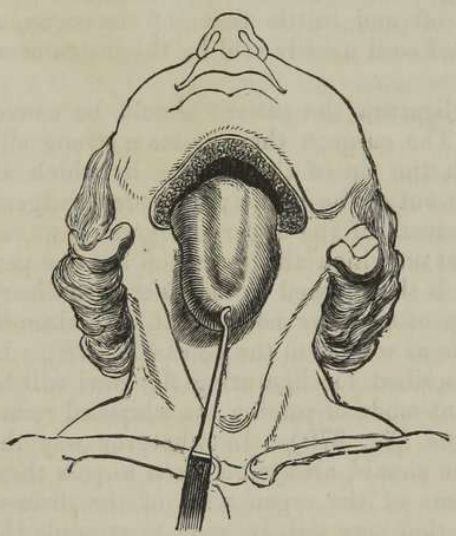
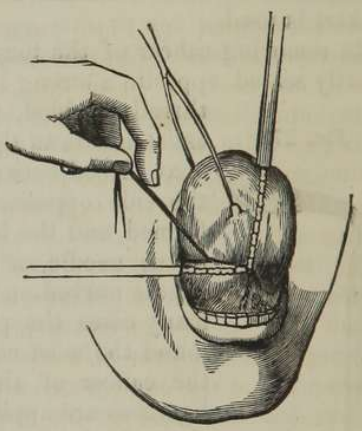


Fig. 281



or more instruments are commonly required, which, as Chassaignac represents (fig. 281), must be passed through the substance of the tongue in opposite directions, so as to isolate and detach the diseased portion of the organ.

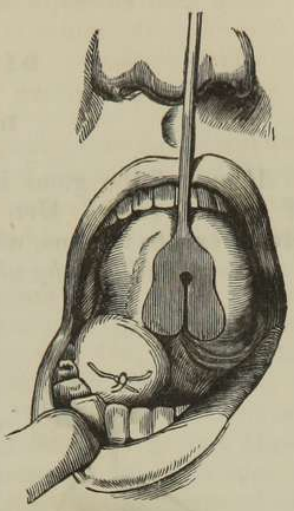
When, however, the floor of the mouth is implicated in the morbid action, nothing should, I think, be attempted, as it is impossible to extirpate the whole of the disease, and partial removal of it will only be followed by rapid recurrence and increased activity of development. I do not think that the enlargement of the submaxillary glands merely should be any bar to the operation, provided the disease be limited, and the constitution good, as under these circumstances the glands may be excised, as well as the disease of the tongue removed; or, if they be not of any very considerable size, they may be left, when they will perhaps subside without the necessity of operation, as their enlargement may probably be dependent upon simple irritation; or should they continue indurated, they may readily be removed at a subsequent period.

Tumors of various kinds, encysted, fatty, and erectile, are met with in the tongue, and underneath it in the floor of the mouth. They require extirpation by the ligature, or enucleation with the handle of the scalpel or fingers, according to their situation and size, and for these irregular operations no special directions can be given. In removing such tumors as these, when situated under or by the side of the tongue, the knife must necessarily be used with much caution. It must, however, be borne in mind, that if these growths cannot be reached from the inside of the mouth, they may be got at by incision through

the mylo-hyoid region, where there is but a slight thickness of soft parts between the surface and floor of the mouth.

Ranula is perhaps the most remarkable of these buccal tumors. This disease occurs under two forms; 1st, as a globular swelling, semi-transparent, evidently containing fluid, and often attaining the size of a walnut or pigeon's egg, situated under the tongue, pushing this organ upwards and backwards, and consequently interfering with deglutition and speech (fig. 282). The walls of the cyst are usually thin, with small vessels ramifying on them; its contents are glairy and serous. This form of ranula is usually said to be a dilatation of Wharton's duct; but it certainly appears to me that there is no proof of the disease being of this nature, and, indeed, it is not very easy to understand how so small a duct can be dilated to so large a size as is occasionally attained by these tumors, which seem, in some cases at least, rather to consist of distinct cystic formations such as commonly occur in connection with other secreting glands. The *treatment* of this form of ranula consists either in passing a seton through its walls, so that contraction may take place on this, or else in the excision of a large portion of the anterior wall of the cyst, the remainder contracting, until it at last becomes obliterated.

Fig. 282.



2d, Besides the ordinary form of ranula, an encysted tumor, partaking of this character, is occasionally met with, lying above the mylo-hyoid muscle, between it and the buccal mucous membrane, projecting, however, more distinctly into the neck than into the mouth; occupying, perhaps, all the space between the lower jaw and the os hyoides on one side, and attaining the size of an orange. In a case of this kind in a lad of twenty, lately under my care, the contents of the tumor, which closely resembled cream cheese in character, were found to be composed of well-formed epithelial scales and much fatty matter. Such tumors are, I think, best treated by having a free opening made into them from the mouth, their contents squeezed or spooned out, and the cavity being stuffed with lint allowed to granulate and contract. If an attempt be made to extirpate them from without, the profuse and perhaps dangerous hemorrhage, the firmness with which the cyst wall is incorporated with surrounding parts, the danger attendant on the free use of the knife in the neighborhood of such important parts as lie between the mylo-hyoid muscle and the base of the tongue, will render such an operation not only an unsatisfactory, but a hazardous procedure.

CHAPTER L.

DISEASES OF THE JAWS.

DISEASES OF THE GUMS.

Abscess of the gums is of very frequent occurrence, from the inflammation of decayed teeth. Here a free and early incision should be made, which, by giving exit to the pus, will afford immediate relief.

Spongy and sloughy ulceration of the gums will occur as the result of constitutional cachexy in any way induced — by mercury, malaria, syphilis, &c. They are best treated by tonics, in conjunction with the chlorate of potass and mineral acids internally. If spreading actively, escharotics, such as the muriatic acid or creosote, may be advantageously applied. If not making much progress, a solution of the nitrate of silver, with chlorinated or tannin gargles, will be useful.

Fig. 283.

Epulis is a tumor of a fibrous character, springing from the periosteum and edge of the alveolus, and implicating the osseous walls, growing up between, and loosening the neigboring teeth, which it displaces and envelopes in its structure. It is most frequently met with in the lower jaw. and commonly about the molar teeth (fig. 283). This tumor is red, smooth, and lobulated, at first hard and semi-elastic, like the ordinary structure of the gum, but after a time softening oy disintegration, and ulcerating on the surface, with a purulent or sanious discharge; it appears simply to be a circumscribed hypertrophy of the gum.

The *treatment* of epulis consists in the removal of the whole of the mass and of that portion of the alveolus from which it springs. As it evinces a great tendency to reproduction, it must not simply be shaved off the bones, but a portion of the osseous structure must be removed as well; unless this point be attended to, the growth will to a certainty be reproduced. In performing the operation, the first thing to be done is to extract a tooth contiguous to and on either side of the tumor; a cut must then be made with a saw through the alveoli of the teeth that have been removed, down to a level with the base of the growth. In doing this care must be taken not to cut too near the remaining teeth, lest the alveoli be opened and their support lost. If the tumor is large it may be necessary to saw deeply, but the base of the lower jaw should in all cases be left intact, the whole of its substance not being sawn through, so that, though a considerable portion of bone be removed, yet the length of the jaw may be preserved. For this purpose Hey's saw should not be used, it is a higgling instrument, difficult to manage in this situation; but a straight and stiff-backed saw, with as deep a blade as the mouth will conveniently admit, will be found most useful (fig. 209). The epulis, included between two vertical cuts, may now be removed with cross-cutting forceps, and the bleeding stopped by placing a plug in the wound and compressing it against the teeth of the upper jaw by means of a bandage passed under the chin. Should there be a spouting dental artery, it may be necessary to apply a red-hot wire in order to arrest its bleeding. The cut surface will speedily granulate, and the cavity fills up with fibrous tissue.

Cancerous ulcers and fungous growths from the alveolar processes, *malignant epulis*, as they are called, occur in the same way as the last; but they are soft,

purplish, very vascular, grow rapidly, and are speedily reproduced after removal; they principally, I think, occur in males advanced in life. The same operation requires to be practised for these diseases as for the simple epulis, and as there is usually much hemorrhage following their removal, a red-hot iron must be applied to the bleeding surface.

DISEASES OF THE ANTRUM AND UPPER JAW.

Our present knowledge of diseases of the jaws, and of the operative procedures necessary for their removal, is chiefly due to the labors of Gensoul and of Liston. Mr. O'Shaughnessy also, who appears to have had many opportunities of witnessing these affections amongst the natives of India, has added much to our acquaintance with their pathology and treatment.

The *antrum* may be the seat of fluid accumulations or of solid tumors. *Dropsy of the antrum* from accumulation of mucus within this cavity occasionally occurs. As the aperture leading from this cavity into the nose is a little above its floor, there may be a natural tendency for the fluid secreted here to accumulate to some extent before it is discharged. If, however, this aperture be from any cause blocked up, the secretion may increase to so great a degree as to occasion serious inconvenience by its outward pressure. In cases such as these, the accumulation of fluid has been known after a time to expand the walls of the cavity; and in this way the floor of the orbit or the roof of the mouth may be caused to bulge, the nasal cavity may be encroached upon, and the cheek rendered round and prominent — an indolent semi-elastic tumor forming in it and protruding it outwards, and giving rise to the egg-shell or parchment crackling on pressure. The treatment in these cases consists in making an opening into the cavity of the antrum with a strong perforator through its most expanded and thinnest part, and leaving a plug of lint in the aperture, so as to allow the discharge to escape freely. The shape of the cheek may be restored by the gradual pressure of a spring pad or double-headed roller.

Suppuration may take place in the antrum, being usually excited by the irritation of a carious molar tooth, or by some injury of the face, and occasioning perhaps much pain, with throbbing or lancinating sensations. The pus, as it forms, will sometimes overflow, as it were, into the nose through the aperture between these cavities, and then may keep up constant irritation, with much fetor in the nostrils; in other cases, it drains through the socket of a tooth into the mouth; and in other instances again, its exit being prevented, it gives rise to enlargement of the cheek, the soft parts of which become brawny and inflamed, and the bones expanded, so that at last they are thinned to such an extent, that, as in dropsy of the cavity, they crackle when pressed upon. Any portion of the wall of the cavity —the orbital, buccal, palatal, or nasal—may thus be expanded and fluctuation be felt through it, and the lachrymal duct being commonly obstructed, the eye on the affected side becomes watery.

Fig. 284.

The *treatment* of this condition consists in the extraction of any carious tooth seated in the neighborhood of the antrum, or if they be all sound, in the removal of the second molar, the fangs of which come in close relation to, and frequently perforate the bottom of the cavity. In this way an exit should be given to the matter; but as it will not discharge itself sufficiently freely, the antrum must be opened through the alveolus, or through the canine fossa under the cheek, provided it be much expanded in this situation, so that its cavity is easily reached. The perforation into the antrum may readily be made, or the socket of the tooth enlarged, by means of a triangular antrum-perforator, such as here represented (fig. 284). As the matter draws away, the cavity will gradually contract, and the deformity thus be removed. It is well not to attempt

to perforate in the site of teeth that have been extracted for some length of time, as here the bone becomes unduly consolidated, and I have consequently seen failures in reaching the cavity occur. The matter that is discharged is often very offensive, or it may be thick and pasty from the absorption of its watery parts. After the aperture has been made, the cavity should be syringed out with tepid water, and its shape gradually restored by pressure.

Tumors of various kinds spring from the upper jaw, taking their origin either from its surface, from the interior of the antrum, or from the pterygo-axillary fossa. Those that grow from the surface of the bone, are either some of the various forms of epulis that spring from its alveolar border, and must be treated as already described, or they are exostoses growing from the outer surface of the bone, projecting perhaps up into the orbit, and requiring removal with the saw, bone-nippers, or gouge. In doing this, care must be taken not to destroy the nasal process of the bone, lest the lachrymal sac be opened.

The tumors that spring from the cavity of the antrum or from the posterior part of the upper jaw are of very various kinds;—fibrous, cartilaginous, osseous, fatty, fibro-plastic, erectile, and encephaloid growths may all be met with in this situation. In the Museum of University College, which is very rich in specimens of these tumors, most of the above varieties will be found. The fibrous tumor is perhaps the most common; it principally occurs in elderly people, and may attain a very considerable bulk. The encephaloid comes next in order of frequency, and the osseous and enchondromatous occur, but are extremely rare. The osseous tumors are remarkable as occasionally appearing to set up a spontaneous attempt at elimination, by necrosis taking place in them. These various growths are most commonly connected with, or spring from, the mucous membrane of the antrum, and in growing gradually expand and dilate the walls of this cavity, pressing the bone outwards, thinning them, and giving rise to a considerable outward projection of one side of the face. The tumor thus formed is usually smooth, round, or oval, slightly lobed perhaps, more especially if of a fibrous character, and has in many cases a tendency to hang downwards so as to overlap the lower jaw to a certain extent; at the same time it encroaches more or less upon the other cavities lying in the vicinity of the antrum. Thus, it pushes down the palate, causing considerable swelling in the roof of the mouth; displaces the alveolar processes and teeth, giving rise to irregularity in their outline; and when encroaching upon the orbit, occasioning stillicidium lachrymarum, or even impairment of vision. As the tumor enlarges, it obstructs the nasal cavity, and stretching back into the pharynx, interferes with respiration and deglutition. When it is of an encephaloid character, obstruction of the nasal fossa will be found to be one of its earliest signs; and the integuments will be observed speedily to become involved, the gums implicated, and the submaxillary absorbent glands enlarged.

In the diagnosis of these tumors there are three principal points to be attended to: — 1st, to distinguish them from fluid accumulations; 2d, to determine whether the growth is simple or malignant; and, 3d, to ascertain its seat. In making the diagnosis from fluid accumulations in the antrum, the history of the case, and the uniform enlargement of the cavity without the tumor projecting externally beyond any part of its walls, may enable the surgeon to determine that it is not of a solid character. But in many cases this is not sufficient, and it becomes necessary to have recourse to an exploratory puncture by means of the perforator, through one or other of the more thinned and expanded parts already indicated. This should never be omitted in cases of doubt, for it has happened even to so good a surgeon as Gensoul, that after making incisions through the cheek with the view of extirpating the tumor, the bones were found to be expanded by an antral abscess, and that, consequently, the operation had been undertaken unnecessarily.

In determining whether the growth be of a simple or malignant character,

the surgeon will experience much difficulty, so long as it is confined to the cavity of the antrum; but when once it has perforated and got beyond its walls, this point is easily solved. Whilst the tumor is still confined within the antrum, much light may however be thrown upon its nature by attention to the rapidity of its growth; the greater this is, the more reason there is to suspect its malignant character. But though attention to this sign is of value, yet too much importance must not be attached to it; for though as a general rule, the fibrous and cartilaginous tumors may increase less rapidly than the malignant, yet it may happen that these attain a very great bulk in a short space of time. With regard to the age of the patient, that is of comparatively little value in a diagnostic point of view. I think, however, that as a general rule, simple tumors most frequently occur in the young, whilst the malignant forms of the affection are commonly met with at the middle or advanced periods of life. It is of much importance, even in a diagnostic point of view, to examine the condition of the submaxillary glands. When the disease is malignant, they become enlarged and indurated, at a very early period. In a case lately under my care, the malignant character of a tumor whilst still in the antrum, was determined by the fact of there being a long chain of indurated lymphatic glands, lying under the angle of the lower jaw, where they had become secondarily affected by absorption, before the bones had been perforated by the growth. When once a malignant tumor has got beyond the cavity of the antrum, and is thus relieved from the pressure of its walls, it grows with great rapidity, insinuating itself extensively amongst the bones of the face and skull, by creeping through the foramina and fissures, encroaching greatly on the nasal cavity and orbit; implicating the integuments of the cheek and soft structures within the mouth; and throwing out sprouting masses in these several situations, which present all the characters of the true malignant fungus.

A point of very great importance in relation to operative interference is to determine whether the tumor springs from the cavity of the antrum, or takes its origin behind the superior maxilla in the pterygo-maxillary fossa. In the former case, the nasal or palatal walls of the antrum are expanded, and the line of teeth rendered irregular. In the latter, the maxillary bone will be found to be simply pushed bodily forwards, there being little if any deformity in its outline, the line of teeth not being displaced, or the walls of the antrum, — palatal, nasal, or orbital, expanded. Yet it must be borne in mind that the difficulty of the diagnosis is greatly increased by the fact that a tumor, though not originating in the antrum, may pass into the orbit, through the spheno-maxillary fissure, and may make its way forwards amongst the bones of the face, partly by creeping through, and partly by displacing them.

In the *treatment of tumors of the antrum*, nothing can be done except to extirpate the growth; and it is consequently of great importance to distinguish those forms of the disease in which an operation can be undertaken with safety, and with a fair chance of success, from those in which none should be performed. When the tumor, springing from the antrum, is of a simple character, the disease should be removed, together with the whole of the superior maxilla, the tumor, whatever size it has attained, being generally encysted, and the bones expanded around it; so that it is well bounded, and does not implicate neighboring parts. Here, as Liston justly observes, no nibbling or grubbing operations should be done, but free excision of the whole mass practised. When the tumor springs from the pterygo-maxillary fossa pushing the bones of the side of the face forwards, I think it is doubtful whether the surgeon ought to interfere, as the base of the skull may be implicated to such an extent that the patient may die a few hours after the operation, as I saw happen in a case of Liston's. When once a malignant growth of this part has passed beyond the osseous boundaries of the antrum, it should not be interfered with. So long as it is contained within this cavity, where indeed it is often impossible

to ascertain, until after removal, the true nature of the affection, it may be excised, provided the glands in the neck be not greatly enlarged. If they are much implicated, even though the walls of the antrum be not perforated, I think it is safer not to interfere, as a cure by operative procedure must be hopeless. Whenever the soft structures of the cheek are involved so as to require partial excision with the tumor, no operation should be performed, as the disease will probably have become constitutional, cannot be completely extirpated, and will speedily recur in the cicatrix.

The operation of the *excision of the upper jaw* together with the malar bone for tumor of the antrum, was first proposed by Lizars in 1826, though Gensoul of Lyons was the first surgeon by whom the operation was actually performed, in May, 1829. It may conveniently be done in the following way: The central incisor on the diseased side having been extracted, the point of a bistoury should be entered opposite the external angular process of the frontal bone, and carried with a semi-circular sweep into the angle of the mouth. From the upper end of this incision, a cut about one inch in length may be carried along the zygoma. Another incision is made from the nasal process of the superior maxillary bone, down to the side of the nose, round the ala, which it detaches, and through the centre of the upper lip into the mouth. The flap thus formed is dissected upwards until the margin of the orbit is reached, the soft parts are then carefully separated from the floor of this cavity, and the infra-orbital nerve dissected and drawn upwards with a curved copper spatula, which protects them and the globe of the eye. The next step in the operation consists in the division of the bones. This may best be done with strong cutting pliers; the zygoma should be first cut across, the external orbital angle next divided, and then the internal angle cut through by putting one blade of the forceps into the nostril and the other into the orbit. The palatal arch must next be cut across by notching it deeply with a Hey's, or a narrow-bladed saw, and then passing the pliers into the mouth and nose, cutting through the line of the groove and the alveolus of the incisor that had been extracted. The whole mass having thus had its osseous connections separated, is depressed, drawn forwards, and readily removed by breaking down adhesions with the finger, or with the bistoury by the division of a few remaining soft parts. In the early stage of the operation, during the incisions through the cheek, there is often a good deal of hemorrhage; this may be arrested by pressure, or by the ligature of any vessels, such as the facial, or transverse fascial, that bleed with great activity, and if necessary by the application of the actual cautery to the bones. However much the soft parts may be stretched no skin should ever be removed, as it will all eventually contract. In the later stage of the operation after the removal of the tumor there is not so much hemorrhage as might be expected, though some branches of the internal maxillary will require ligature. By an operation such as this, the whole of the superior maxillary and malar bones may, if necessary, be removed, and the large cavity that is left between the eye and mouth, having some lint introduced into the bottom so as to support the parts in the orbit and the cheek, may be allowed to granulate; the cheek being replaced and retained in situ by a few points of twisted suture evenly introduced through the line of incision in it, and in the upper lip. After cicatrization is complete, the deformity resulting from such a procedure will be far less than might at first be anticipated.

In some cases the malar bone and floor of the orbit will be found to be sound. When this is the case they should both be left, and with this view, after the cheek has been turned up, as just described, a deep groove should be made with a narrow, straight-backed saw, below the orbit directly across from the nasal process of the maxillary, and the outer edge of the malar bones. The removal of the growth may now be effected by cutting through the nasal process

with the forceps, and then applying them to the horizontal groove made below the orbit, after which the palatal arch may be divided as already directed.

Mr. Fergusson has in some cases succeeded in removing tumors of considerable magnitude by a single incision through the cheek, from the angle of the mouth upwards and outwards; and in other cases by slitting open the upper lip in the mesial line, and then carrying the knife along the side of the base of the columna into the nostrils, by which simple incision this distinguished surgeon has shown, that sufficient relaxation of parts can be obtained to excise the greater portion of the superior maxillary bone.

DISEASES OF THE LOWER JAW.

The lower jaw is not unfrequently the seat of necrosis, which may arise either from some constitutional cause, from local injury or irritation, or from the specific action of the fumes of phosphorus. In this disease we must wait until the bone has become loosened, and then by incisions through the gum, or through the structures of the lower part of the cheek, or under and along the lower angle of the jaw, reach the diseased bone and extract this; separating, if necessary, any part that may still be adherent by means of cutting pliers.

Tumors not unfrequently spring from the lower jaw. Like those in the superior maxilla they may either be simple or malignant. Amongst the simple, we most commonly find the fibro-cystic. Fibrous tumors are also occasionally met with, and more rarely osseous and enchondromatous growths. The malignant tumors are principally of an encephaloid character. These various growths frequently occur in early and middle life, and usually spring from the diploe, between the two tables of which the bone is composed. They project into the mouth and on to the side of the neck, forming large rounded uniform, or imperfectly lobed masses. Occasionally malignant diseases spring from the neighborhood of the bone, and, without invading its structure, envelope it so as to give rise to an appearance of morbid implication of it.

Epulis not unfrequently springs from the alveoli of the lower jaw; however large this may be, it is always a disease of the alveoli, and can implicate the bone only by extension to it. It is usually sufficient to remove the mass with the alveoli from which it grows, the base of the bone being left, which is a great advantage, as it prevents shortening of the jaw.

Operation. — Extract the tooth on either side of the growth, cut with Hey's saw down the alveolus on either side, then make a cross-cut under the tumor into the bone with the saw, and next apply cross-cutting forceps so as to remove it.

In the cystic and fibro-cystic tumor of the jaw the growth is expanded into cysts having more or less solid matter intermixed, partaking of the character of epulis. These cysts are of various degrees of thickness; some being thin and membranous, others having the walls partly composed of fibrous tissue, and others again having expanded bony lamellæ largely entering into their composition, so that on pressure they occasionally communicate the semi-crepitant sensations peculiar to the cystic expansions of the osseous structure. The fluid contained in these cysts is a viscid liquid, usually semi-transparent, yellowish, or bloody.

In the lower, as in the upper jaw, it is of great importance to diagnose the simple from the malignant affections, as in the latter form of disease an operation is rarely justifiable, the soft tissues around the bone being usually implicated to such an extent as not to admit of removal, and consequently of the full and complete extirpation of the disease. The malignant tumors may generally be readily detected by the rapidity of their growth, their pulpy or elastic character and infiltration of neighboring parts, with implication of the sub-maxillary glands.

The *treatment of tumors* of the lower jaw depends in a great measure upon

the character of the growth. In cystic tumors of moderate size, with thin walls and but little deposit of fibrous tissue around the cysts, the best mode of treatment consists in cutting down on the expanded portion of bone, opening the cyst by means of the antrum-perforator, small trephine, or cutting-pliers, according to its size and the thickness of its walls; letting out the fluid contained within, and then by introducing a plug of lint get it to granulate from the bottom, and gradually to contract. When the cysts are so large that they have destroyed the integrity of the bone, or when they are associated with a large quantity of fibrous tissue, so as to constitute true fibro-cystic tumors, excision of the diseased bone must be practised. This, also, is the only plan of treatment that can be had recourse to in other affections of this bone.

The operation of *excision of a portion of the lower jaw* for tumor of that bone was first performed by Dupuytren. As the growths for which this operation is performed are usually situated between the symphysis and angle of the bone, seldom extending beyond the middle line, the operation is generally limited to one side of the face. In some instances, however, the tumor may encroach so far that it may be necessary to remove more than the half of the bone; and in other cases, again, though of very rare occurrence, the whole of the bone has been disarticulated.

When the tumor is of small size, and is situated about midway between the symphysis and angle of the jaw, it may be reached by making a semi-lunar incision of sufficient length under the lower edge of the bone, dissecting up the flap thus formed, then carrying the knife cautiously along the inner side of the jaw, so as to detach the mucous membrane of the mouth and the mylo-hyoid muscle to a sufficient extent. One of the teeth on either side of the tumor having been previously drawn, the jaw must now be deeply notched through their alveoli into its base with a narrow strong-backed saw, and cut through with pliers. After the fragment of diseased bone, with the attached tumor, has been removed, the teeth should be tied together with strong silver wire, or a silver cap should be fitted upon the teeth of the two portions of bone that are left, and attached by an elastic spring to another silver cap put on those of the upper jaw, so as to prevent the displacement that would otherwise occur in the smaller fragment. Union takes place after a time by fibrous tissue, which becomes sufficiently dense to make the jaw strong and useful. In those cases in which the tumor encroaches upon the angle and ramus of the jaw, it is better to remove the bone at the articulation on the affected side, for if the articular end including the coronoid process be left, it will be displaced forwards and upwards by the action of the temporal and external pterygoid muscles, and be a source of much inconvenience and irritation to the patient, unattended by any corresponding utility. In these cases the removal of one lateral half of the jaw will consequently be required, and the operation may be performed in the following way: — The point of a strong bistoury or scalpel should be entered immediately behind the articulation, carried down the posterior margin of the ramus behind the angle, and under the body of the bone beyond the anterior limits of the tumor, where it must slope gradually upwards, terminating at some distance from the lips, which should not be encroached upon; the convex flap thus formed is dissected up, and the facial artery and any other branches requiring ligature tied. The knife is then carried behind the jaw in front of the tumor, and one of the incisor teeth having been extracted before the operation commenced, a saw should be applied to the bone in this situation, and its section finished by means of the cutting-pliers; the surgeon then dissects under and around it; in this situation a scalpel, curved on the flat, will be found useful, keeping the edge of the knife close to the bone and tumor. When he has cleared the tumor and ramus, he depresses the body of the bone forcibly with his left hand, in order more readily to divide the attachment of the temporal muscle to the coronoid process. This having been done, the only part left is

the disarticulation, which is best effected by opening the joint from the front, whilst the bone is well depressed and twisted somewhat outwards, the edge of the knife being kept close to its neck, scraping the bone so as, if possible, to avoid wounding the internal maxillary artery, when any remaining attachments having been cut through, the disarticulation is effected. In depressing the bone to get at the temporal muscle and the joint, care must be taken not to use too much force, lest it happen that the ramus gives way, having been weakened by the disease; a good deal of trouble being consequently experienced in removing the fragment left behind, which can only be done by seizing it with necrosis forceps, thus dragging it forwards, and then dividing the muscle and capsule. Should the internal maxillary artery have been divided, it must be ligatured, or the termination of the external carotid, where the vessel divides into the temporal and internal maxillary, tied: any other branches that bleed will necessarily also require the ligature; and then the cavity having been lightly filled with lint, should be left to granulate; the cheek being laid down and attached along the line of incision by hare-lip pins and twisted sutures. A kind of fibrous tissue forms in place of the jaw that has been removed, and comparatively little deformity results. When the disease of the bone extends beyond the symphysis, a thick ligature should be passed through the end of the tongue, which must be drawn forwards by an assistant, lest on the division of the insertion of its muscles into the lower jaw it be forcibly retracted into the pharynx, and thus occasion suffocation.

CHAPTER LI.

DISEASES OF THE THROAT.

CLEFT PALATE.

Various degrees of congenital deformity may occur in the palate and uvula; thus the uvula alone may be bifid, or the cleft may extend through the greater part or the whole of the soft palate; or, the hard palate may be divided as well; and, lastly, the separation may extend forwards to the integuments of the face, giving rise to the complication of hare-lip. The soft palate and uvula are most frequently cleft without the hard palate being divided; but, in some, though rare cases, the lip and the hard palate are fissured without the soft one being cleft. These malformations necessarily give rise to great inconvenience, by interfering with deglutition, and rendering the speech nasal and imperfect. During the swallowing of fluids, especially, there is a tendency to regurgitation through the nose, though this is occasionally prevented by the approximation of the edges of the fissure.

In the *treatment* of these malformations, the first question to be determined is the age at which the operation should be performed. As the success of the operation depends in a great measure upon the patient remaining perfectly tranquil and steady during the necessary procedures, which are of a tedious and protracted character,—upon his assisting the surgeon by opening his mouth, and not struggling on the introduction of the instruments, —and, after the operation, in making as little movement as possible in speech or deglutition for some days; it is usually considered expedient not to interfere with this malformation until the patient has attained the age to understand the necessity of remaining quiet, and to be able to control his movements; but yet some recent

observations by Fergusson and Sédillot have shown that the necessary operation may be done successfully on young children. It need scarcely be remarked, that the general health ought to be in the best possible state, before any procedure requiring immediate union of parts be attempted.

The operation for the cure of a cleft in the soft palate may be said to have been introduced by Roux; for although several attempts at the cure of this deformity had been made by surgeons before his time, yet he was the first to establish *staphyloraphy* as a distinct operation. Many modifications of Roux's plan have been practised by Graefe, Warren, and others, in order to render it more easy of execution and certain in its results; but to Fergusson is due the great merit of introducing a new principle of treatment in the operation—viz., the application of myotomy to it, and thus paralyzing the movements of the muscles of the palate. Fergusson found that the great cause of failure in these cases was the mobility of the parts, and the traction exercised by the muscles, principally the levator palati, and the palato-pharyngeus on the line of union; in order to obviate this, he conceived the happy idea of dividing these muscles. Before Fergusson laid down the principles of this operation, various cuts had been made in the palate by different surgeons, with a view of taking off the tension after the sutures were tied, more especially two parallel incisions, one on either side of the line of union; these, however, were done almost at haphazard, and in an empirical way, without the recognition of any distinct principle being involved.

In the operation, as performed by Mr. Fergusson, there are four distinct stages. 1st. The muscles of the palate are divided, by passing a curved lancet-ended knife through the fissure behind the velum, midway between its attachment to the bones and the posterior margin, and about half-way between the velum and the end of the Eustachian tube; by cutting deeply with the point of the knife in this situation the levator palati is divided. The uvula is then seized and drawn forwards, so as to put the posterior pillar of the fauces on the stretch, which is to be snipped across, so as to divide the palato-pharyngeus. 2d. The next step in the operation consists in paring the edges of the fissure from above downwards by means of a sharp-pointed bistoury. This is best done by seizing the lower end of the uvula, putting it on the stretch, and cutting first on one side and then on the other, leaving the angle of union to be afterwards removed. The patient should then be allowed to remain quiet, and to gargle the mouth with cold water or to suck ice, so as to stop the bleeding. 3d. When this is arrested, the surgeon proceeds to the next step, that of introducing the sutures; this may be done by means of a nevus needle, armed with a moderate-sized thread, being passed from below upwards on the left side of the fissure, about a quarter of an inch from the margin; the thread should now be seized with forceps, and one end of it pulled forwards through the fissure. This may again be threaded in the needle and passed through the opposite side of the fissure from behind forwards, through the right side; as the point of the needle appears, the thread should again be seized and the needle at the same time withdrawn; the suture is then tied by means of the surgeon's knot, and in this way from two to four sutures may be passed, according to the extent of the fissure, tied lightly, and the knots cut close. In tying the knots great care should be taken that no undue traction be exercised upon the parts; in fact, the use of the sutures is not to draw, but simply to *hold*, the parts together; the division of the muscles has caused these to be relaxed, so that they hang down loosely and merely require to be held in apposition by the sutures. The patient must next be put to bed, and every care taken to avoid any movement of the palate. He should be restricted to fluid but nourishing food for a few days, and should be directed to swallow this with as little effort as possible, and indeed should not be allowed anything solid until complete union has taken place. All coughing, spitting, or swallowing of the saliva should be interdicted.

4th. The stiches should be left in for several days, and indeed need not be disturbed so long as they produce no irritation. They usually require removal by the eighth or tenth day, but occasionally may be left with advantage for some time longer, until they excite irritation, or until union is perfect; they should then be cut across with scissors and drawn out, the upper one first, the middle next, and the lower one last. Should there be any aperture left in the palate, where union has not taken place, this may be closed by touching it with a point of nitrate of silver.

The voice in these cases does not usually at once recover its natural tone after the operation, although in some cases it may; but at the end of a month or six weeks the patient may be put through a course of instruction with a view of regulating the movements of the tongue and the actions of the soft palate.

Fissures of the hard palate are usually closed by means of "obturators" made of gold, vulcanized India-rubber, or ivory. Dr. Warren, of Boston, has proposed to close the fissures here by dissecting the soft tissues from the palatal arch between the margin of the cleft and the edge of the gum, and then uniting them in the middle line by means of stiches, in the same way as in fissured soft palate.

This operation has lately been brought before the profession in this country by Mr. Pollock, who has invented some ingenious instruments for its proper performance.

Mr. Pollock's operation is as follows: — An incision having been made along the edge of the cleft, at the junction of the nasal and palatal mucous membranes, the soft covering of the hard palate is carefully dissected or scraped down off the bones by means of curved knives, great care being taken that the mucous membrane and its subjacent fibro-cellular tissue, which varies greatly in thickness in different cases, are not perforated; when this has been well loosened on either side, it will be found to hang down as a curtain from the vault of the mouth, — the two parts coming into apposition along the mesial line, or possibly overlapping.

The edges being then smoothly pared, are brought into apposition by means of a few points of suture introduced in the ordinary way and without any dragging. On this point great care is necessary. The knots having been tied, the patient is confined to bed for several days, and on an abundant, but fluid or pulpy diet. Union will usually be found to be perfect at the end of a week. At a later period, the fissure in the soft palate, which always accompanies that in the hard, should be cleared; but it is of the greatest consequence that this be not attempted at the same time that the operation is done on the hard palate.

In dividing the levator palati, Mr. Pollock adopts a different practice to that of Mr. Fergusson. Instead of cutting from behind, he passes a ligature through the curtain of the soft palate, so as to contract and draw it forwards; and then pushing a narrow-bladed knife through the soft palate to the inner side of the hamular process, by raising the handle and depressing its point, he divides readily the muscular fibres. This method of dividing the levator palati, which is analogous to the plan employed and depicted by M. Sédillot (figs. 285 to 288) appears to be more simple and easy of execution than the division of the muscles of the velum from behind. The gap that is left closes without difficulty by granulation, and seems still more to take off tension from the parts.

The *uvula* occasionally becoming elongated, and hanging down into the pharynx so as to touch the epiglottis and sensitive mucous membranes in its neighborhood, gives rise to a tickling or spasmodic cough which can only be cured by removing the pendulous body. This little operation may be readily done by seizing the end of the uvula, with a pair of polypus forceps, and snipping across its root. Of late I have been in the habit of using a pair of "vul-

sellum scissors" (fig. 289), which I have had constructed for the purpose, by which the uvula is cut off at the same moment that it is seized, thus rendering the operation easier and less irritating to the patient.

Fig. 285.

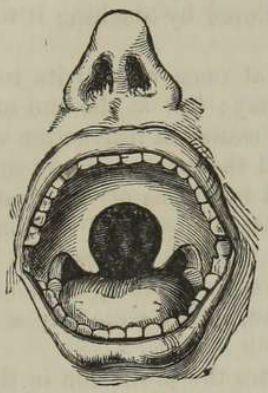


Fig. 286.

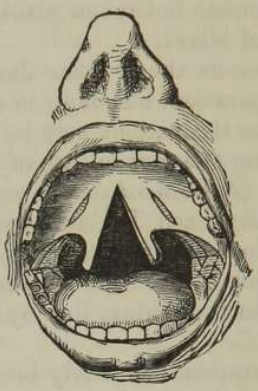


Fig. 287.

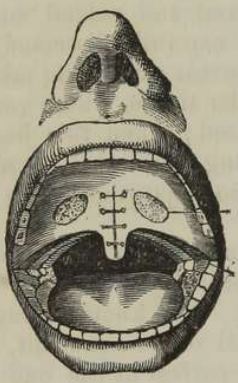
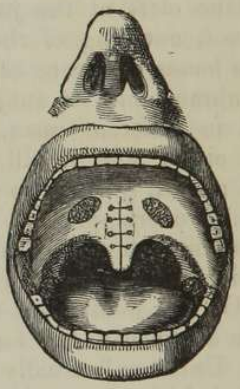
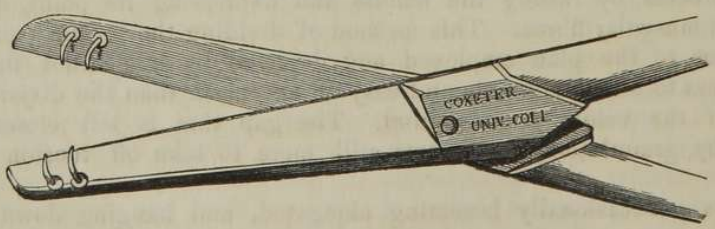


Fig. 288.



The *tonsils* are not unfrequently the seat of disease, becoming inflamed or permanently enlarged. When inflamed they become swollen and red, with much pain in the side of the neck and ear, increased by any attempt at swallowing; there is usually rather a profuse secretion of saliva, and a good deal of swelling under the angles of the jaws; the tongue is much coated with thick

Fig. 289.

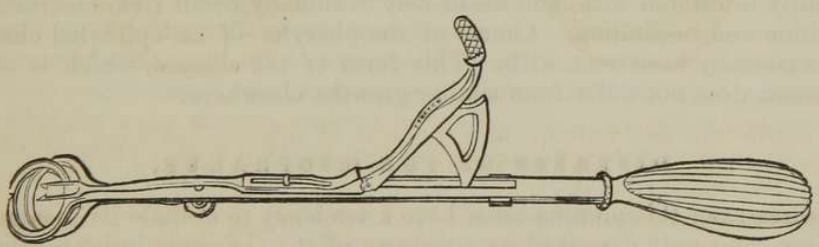


pasty mucus, and the voice is thick and nasal. The *treatment* consists in the application of leeches under the jaw, of fomentations, the inhalation of the steam of hot water, and low diet, which need scarcely be enforced, on account of the difficulty and pain in swallowing. If the mouth can be opened, much

relief may be given by scarifying the tonsils with a probe-pointed bistoury, and if abscess form, it should be opened early, which may most readily be done with a gum-lancet.

The tonsils often become chronically indurated and enlarged, sometimes as the result of repeated attacks of inflammation of these parts, but in the majority of instances independent of any inflammatory mischief, though when once enlarged these organs are constantly liable to inflammatory attacks. Hypertrophy of the tonsils most commonly occurs as a strumous disease in scrofulous children, who have a tendency to congestion of the mucous membrane of the nose, and to enlargement of the lymphatic glands of the neck. In such cases as these the enlargement of the tonsils may gradually subside as the child grows older and stronger, and the treatment should be directed to the improvement of the general health and strength, by means that are ordinarily had recourse to in the management of strumous affections; the internal use of iron and the local application of the tincture of iodine or of nitrate of silver being occasionally serviceable. In the majority of instances, however, the disease will not be influenced by any therapeutic means that may be adopted; and as the enlargement, continuing or increasing, gives rise to difficulty in respiration, and thus interferes with the due arterialization of the blood in the lungs, and impairs the child's speech, it becomes necessary to remove the projecting portions of the enlarged growths. This may most conveniently be done by means of the ordinary tonsil-guillotine; the ring of the instrument being passed over the tumor, the cutting blade is pushed forwards, and thus a slice of the projecting part of the growth is removed. In some cases not a little difficulty is experienced in getting the tonsil fairly into the ring of the instrument, more particularly if the child is unruly; this may be obviated by drawing it through with a vulsellum or double hook, and indeed in some of the machines sold for the purpose a kind of prong is attached, which being fixed into, draws forwards the tonsils before it is sliced off (fig. 290). In performing this operation, especially

Fig. 290.



in children, it is most convenient for the surgeon to stand behind the patient, as he can thus look better into his mouth and has more command over the head. Should a guillotine not be at hand, the tonsil may be removed by seizing it with a vulsellum, drawing it forwards, and then taking off a slice with a probe-pointed bistoury, the base of the blade of which should be wrapped round with a piece of plaster, to prevent its wounding the tongue. In excising the tonsil in this way, care must be taken to cut downwards and inwards towards the mesial line, and on no account to turn the edge of the knife outwards lest the internal carotid artery be endangered. The hemorrhage that follows this operation is usually very trifling, but I have known it to be sufficiently abundant to endanger the patient's life. In such cases ice and gallic acid will usually arrest the bleeding. In one case to which I was called I found a gargle of spirits of turpentine suspended in mucilage effectual after all other means had failed.

DISEASES OF THE PHARYNX.

Inflammation of the pharynx of a diffuse erysipeloid character, with low fever, not unfrequently occurs; it is best treated by the application of a strong solution of nitrate of silver, the use of emollient gargles, and the internal administration of ammonia, with bark, stimulants, and support. If it have a tendency to run into sloughing action, the internal administration of the mineral acids, with bark and stimulants, the nitrate of silver lotion and chlorinated gargles are useful. Sometimes abscess forms in the substance of the velum, and then requires to be opened with the knife that is delineated at page 346.

Abscess occasionally forms in the cellular tissue behind the pharynx, the posterior wall of which is consequently pushed forwards so as to occlude the posterior nares, giving rise to a peculiar nasal intonation of voice; it also may interfere with breathing by pressing upon the upper part of the larynx. This kind of abscess is often connected with disease of the bones at the base of the skull, or of the upper cervical vertebræ. In many cases, if left to itself, it would burst through the mucous membrane into the mouth, but in others it comes forwards under the sterno-mastoid muscles into the forepart of the neck. By exploring the pharynx with the finger, which may readily be done, tension and fluctuation through its posterior wall may easily be made out. In these cases, the treatment simply consists in letting out the matter by puncturing the tense membrane covering it. This may be done by means of a sharp-pointed bistoury properly protected, or the ordinary abscess knife. The pus let out is usually offensive, even though the bones be not affected.

Tumors are occasionally met with in the post-pharyngeal cellular tissue, giving rise to the same swelling, difficulty in respiration, and deglutition, and lateral projection, as occurs in abscess of this region. These growths are mostly cancerous, and speedily prove fatal. Polypi in the pharynx usually come down from the nasal cavities, but sometimes spring from the inside of this canal on one or other of its margins. They are usually, when truly pharyngeal, of a malignant character, and grow with great rapidity. The uses of the part are necessarily interfered with, and death may eventually result from obstruction to deglutition and respiration. Cancer of the pharynx of an epithelial character has occasionally been met with. This form of the disease, which is of rare occurrence, does not differ from similar growths elsewhere.

DISEASES OF THE ŒSOPHAGUS.

All diseases of this mucous canal have a tendency to occlude its passage, and hence are commonly described as *strictures* of it. In some instances the constriction of the œsophagus may be of a purely nervous or spasmodic character; but in the majority of instances it is the result either of fibrous or cancerous degeneration of the walls of the canal, or of the projection of malignant growths into its interior.

The *spasmodic stricture* usually occurs in hysterical women, and not unfrequently results from local irritation occurring after the removal of a fish-bone or some such body from the canal. It is often chiefly seated in the constrictors of the pharynx. In it the symptoms are usually intermittent, the patient experiencing difficulty in swallowing certain articles of food, or at particular periods of the day, whilst at other times deglutition is perfect. In many instances it appears simply to be a variety of the hysterical globus. In the treatment of this affection, the patient must be put upon an anti-hysterical plan, with cold douches and electricity to the neck, and the occasional introduction of the bougie to blunt the sensibility of the part.

Organic stricture of the œsophagus usually occurs either at the commence-

ment or end of the canal, most frequently at the former, opposite the cricoid cartilage. The patient first complains of difficulty in deglutition, he finds that a portion of the food that he has apparently swallowed, returns into his mouth after a time, and that he is obliged at last to confine himself to slops. On examining the œsophagus by means of a bougie, the surgeon will find a part that appears to be constricted, and at which the point of the instrument is either arrested altogether or passes with difficulty. After a time the patient gradually becomes cachectic, and a painful and distressing death will at last occur from low starvation, or from the irritation occasioned by the formation of abscess around the seat of disease.

In the *treatment of organic stricture* of the œsophagus, care should be taken that the patient is principally kept upon nutritious slops, or upon meat that has been well chopped up, as larger fragments are apt to become impacted at the seat of constriction. Means should at the same time be taken to dilate the stricture. If it be of a fibrous character, such a plan of treatment will be of use; if cancerous, it is useless to attempt its dilatation, and upon the whole, I think it better not to irritate the disease by pushing instruments through it. In introducing bougies into the strictured part of the œsophagus, there is often a good deal of difficulty in getting the point of the instrument into the narrowed portion of the canal. This is more particularly the case when the constriction commences suddenly; the œsophagus, as is frequently the case, being dilated into a pouch-like sac above it, in which the food is apt to lodge and the end of the instrument to be arrested, and at the bottom of which a narrow orifice exists, leading into the lower portion of the canal. In these cases much patience and care may be required in overcoming the difficulty. In a patient who had a strictured œsophagus of this kind, who had not swallowed food for nine days, and who was consequently nearly exhausted by starvation, I succeeded, after much difficulty, in getting a No. 5 gum elastic catheter into the stricture, through which nutriment was injected into the stomach. In this case much benefit was afterwards derived by gradually dilating the stricture, which was done on the same principle that has been introduced by Mr. Wakley in the treatment of urethral strictures, — by getting a narrow instrument through the constriction, and then slipping a larger one over it. I first introduced a long narrow bougie through the stricture as a guide, and then slid a gum-elastic tube, well rounded at the end over this; and although the patient eventually died of cancerous degeneration of the œsophagus, with abscess, he was by these means kept alive for many months, enabled to swallow food, and put in a state of comparative comfort. It is needless to observe that, in the treatment of stricture of the œsophagus by bougies, no force should be employed, lest by any accident the walls of the canal be perforated, or the constriction be dependent on the pressure of a tumor or of an intra-thoracic aneurism. Indeed, it is well, in all cases of difficulty of deglutition dependent on lesion of the œsophagus, that the thorax should be examined, with a view of ascertaining whether such disease may exist, before any treatment by dilatation is undertaken. In cases in which the stricture has become impermeable, the patient must necessarily speedily sink, exhausted by starvation. Sédillot seems to think, that, under such circumstances, it would be justifiable to lay open the stomach, with the view of introducing food directly into that organ. This plan, however, appears to be somewhat too heroic to be adopted in practice. The consequence of such an operation would probably be to save the patient the horror of a lingering death from starvation, by more speedily terminating his existence.

DISEASES OF THE LARYNX.

Inflammation of the larynx principally occurs in adults, from exposure to cold, to the infection of erysipelas, or to the general occasioning causes of the low

forms of inflammation; it differs essentially from the croup of children, which is attended by an albuminous exudation, and spreads downwards into the bronchi; whilst in laryngitis, there is no effusion of plastic matter, and the disease is confined to the larynx itself. Laryngitis may not only be of an acute or chronic kind, but it likewise presents two distinct varieties, according to the parts affected, the cause from which it arises, and the condition of constitution in which it occurs; in one, the true *acute laryngitis*, the inflammation is chiefly seated in the mucous membrane and cartilages; in the other, the *œdematous laryngitis*, the affection chiefly occurs in the submucous cellular tissue, within and around the larynx.

In all inflammatory affections of the larynx, whether acute or chronic, there is great danger to life; the rima glottidis, that narrow chink through which all the air destined for respiration must enter, becomes readily occluded, and asphyxia consequently results. This may happen either by the swelling of the lips of the glottis, from the effusion of plastic matter within or upon them, or by the occurrence of spasm in the larynx; indeed, there is always more or less spasm conjoined with all the inflammatory affections of this part of the air-tube, and this spasm being superadded to already existing mechanical occlusion, commonly proves fatal. These laryngeal spasms do not at first recur oftener than at intervals of half an hour or an hour, but as the disease advances they become more frequent, and in any one of them the patient may be carried off. It is of importance to bear in mind that death may occur in these cases, although a considerable portion of the cavity of the larynx continue free. Thus Dr. Cheyne states that there is always in croup at least three-eighths of the cavity of the larynx open for the transmission of air, and that death must consequently result from some other cause than mere mechanical obstruction. This freedom from permanent occlusion commonly occurs in cases of laryngitis, and the immediate cause of death in the majority of instances appears to be spasm, conjoined with defective arterialization of the blood, which becoming dark and poisonous, causes congestion of the lungs or brain, and thus low pneumonia and convulsions.

In acute laryngitis the symptoms are those of local inflammatory action of an acute kind, conjoined with those indicative of interference with the proper admission of air to the lungs. The cartilages and the mucous membrane are the parts principally inflamed, and but little effusion takes place under the mucous membrane; hence the symptoms are not always indicative of such early or intense interference with respiration, as is met with in the œdematous form of the disease. In acute laryngitis there is pain and tenderness on pressing upon the larynx, more especially about the pomum adami. The voice at first is harsh and rough, then stridulous or sonorous, with difficulty in deglutition. The difficulty in swallowing is often at first the most prominent symptom, and continues throughout; dyspnœa, often of a spasmodic character, then comes on, the lips becoming livid, the features pale, and bedewed with perspiration, the eyes watery and bloodshot, and the respiratory muscles being called into violent action, the nostrils are dilated, gasping efforts at breathing, and sudden fits of increased difficulty in inspiring come on; at the same time the pulse becomes feeble, though it continues rapid, and unless efficiently relieved, the patient will speedily sink. When it proves fatal, the acute usually runs into the œdematous form of laryngitis.

The *treatment* in this disease should be actively antiphlogistic. No time must be lost, otherwise the patient will fall into a hopeless state of asphyxia. Free blood-letting, the application of an abundant supply of leeches to the larynx, and the administration of calomel in large doses, with antimonials, must be had recourse to. If notwithstanding the administration of these remedies, the difficulty in respiration continue to increase, the windpipe must be opened before the lungs and brain become irretrievably engorged. It is no easy matter

to determine when it is no longer prudent to trust to active antiphlogistic treatment, and when operation should be had recourse to; indeed the determination of this point may be considered as one of the nicest questions in surgery. As a general rule it may be stated, that if notwithstanding the antiphlogistic means above indicated, the dyspnœa get gradually more urgent, and paroxysms of spasmodic difficulty of breathing become more frequent and severe, then no time should be lost in the performance of the operation, for however short a period the disease may have existed. I can truly say that I have seen several cases lost by delaying the performance of this operation, but never one by opening the windpipe too early. Indeed if the opening be even made somewhat early, I do not think that much, if any, harm results, as the larynx is thereby set at rest; and on the laryngitis being subdued by the continuance of proper treatment, the aperture which simply served as a breathing-hole may be allowed to close by granulation.

In *œdematous laryngitis*, the disease is seated chiefly, if not entirely, in the submucous cellular tissue, and frequently comes on in the course of chronic affections of the larynx. It may, however, be of a distinctly erysipelatous character, occurring as the result of exposure to infection, or to atmospheric vicissitudes. In fact, in many cases it appears to be at times epidemic, and in its pathological conditions resembles closely phlegmonous erysipelas of the part; the mucous membrane becoming red, pulpy, and swollen, and the cellular tissue lying beneath it infiltrated with semi-puriform plastic matter. In this form of the disease, the fauces are reddened, dusky, and swollen; there is much and early dyspnœa, the voice becomes hoarse, rough, and speedily extinct, with much difficulty in deglutition, and on passing the finger over the back of the tongue, the epiglottis will be felt rigid and turgid. There may be some degree of tenderness about the larynx, but the local symptoms, which are less acute, are attended by a greater amount of dyspnœa than in the active form of laryngitis. In œdematous laryngitis there is also a good deal of spasm associated with the local turgescence. These spasms sometimes come on early, and carry off the patient at once, and are very apt to be brought on by speaking or swallowing: but as the disease advances, more continuous dyspnœa may supervene, with great restlessness, a quick, small pulse, and convulsive breathing, the countenance being pale, sunk, and clammy, and the eye dull. Stupor at length supervenes, which speedily terminates in death.

The œdematous infiltration in this form of laryngitis is principally confined to the submucous cellular tissue around the epiglottis, at the margins of the glottis, and to that which lies at the back of the thyroid cartilage. In these situations the tissue is distended with sero-plastic fluid, of an opalescent character, so as almost completely to occlude the rima glottidis (fig. 291). It is a pathological fact of much importance that this effusion never extends below the true vocal cords; being limited at this point by the direct adhesion of the mucous membrane to the subjacent fibrous tissue, without the intervention of any cellular membrane.

Fig. 291.

It is of great importance to make the diagnosis between the two forms of laryngitis. In the acute variety of the disease, antiphlogistic treatment is of great moment; in the œdematous form it is comparatively useless, for here effusion sets in early, and nothing is left for the surgeon but to open the air-passages, so as to give the patient breathing-room, whilst the disease is being subdued. In making the diagnosis, the epidemic character of the affection, the absence of much pain in the larynx, and the dusky-red and swollen fauces point to the œdematous variety. Then also the effect of antiphlogistic treatment should be taken into account. If, after its active

employment, no alleviation of the symptoms occurs, it is only reasonable to suppose that the obstruction to breathing is owing rather to a purely mechanical obstacle than to simple inflammation.

The *treatment* of œdematous laryngitis must be antiphlogistic, though the constitution will not usually bear any very active measures of this description. Leeching under the jaws and over the larynx, the administration of antimonials and salines, will be especially serviceable. In many cases, scarification with a hernia knife or probe-pointed bistoury about the root of the epiglottis, the sides of the glottis, and the back of the thyroid cartilage, will be found the most ready means of unloading the infiltrated mucous membrane. In these cases it is, however, especially necessary to open the windpipe before it is too late, and the lungs become engorged. After the proper employment of the means that have been indicated and their failure, the less delay there is in opening the air-passages through the crico-thyroid membrane the better. The surgeon should not wait until extreme and continuous dyspnœa has set in; this may never occur, the difficulty in breathing being rather of a spasmodic than continuous character, and in one of these spasms life may suddenly become extinct. The lungs also may become fatally congested if the difficulty in breathing be allowed to continue too long. The operation adds but little to the patient's danger, but the increased risk is immense if it be delayed to an advanced period. Not unfrequently this operation is delayed until too late; there is, I think, more risk of doing this than of opening the windpipe too early. When once dyspnœa with laryngeal spasm has fairly set in, every moment is precious, and the patient may at any time be carried off by the recurrence of the spasmodic seizures. The patient does not die gradually asphyxiated, but is suddenly seized with a spasm that terminates his existence.

If the œdematous laryngitis become chronic, sloughing and putrid suppuration of the submucous cellular tissue may occur, as in phlegmonous erysipelas of other parts of the body, and the patient may die partly from asphyxia and partly from typhoid symptoms, with putridity of the breath and mouth. In these cases the administration of stimulants and tonics, more particularly port wine and bark, with free sponging of the part with a strong solution of nitrate of silver, will be urgently required.

The larynx is liable to various chronic diseases of a serious character, some of which are incurable, leaving a permanent impairment of voice, or alteration in the use of the larynx. These affections present great variety, and as many of them are attended by loss of voice, they are included under the general term of *aphonia*. In many cases this affection results simply from cold in relaxed and debilitated subjects, or after long exercise of the voice in persons not accustomed to public speaking. This affection commonly occurs amongst clergymen, and hence is familiarly known as the *clergyman's sore throat;* it is also of frequent occurrence amongst singers, but may be met with among all classes of the community. Aphonia commonly appears to depend upon chronic inflammation of the mucous membrane of the rima glottidis, but is more especially dependent on disease of that extensive mucous surface which stretches from the base of the epiglottis over the back of the thyroid cartilage. In many instances it may also extend into the interior of the larynx, and at last may implicate the vocal cords. In all these situations the membrane is reddened and inflamed, ulcerated at points, and secreting a thin and acrid mucus. In other instances again, the disease implicates the soft palate, the back of the nares, and the neighboring parts; and in these cases the morbidly inflamed surfaces will be seen to secrete a thick puriform fluid, which usually hangs in a broad streak down one side of the posterior wall of the pharynx.

The *symptoms* of this chronic irritation of the mucous membrane in these situations consist of habitual tickling or spasmodic cough, a veiled or hoarse character of voice, with perhaps, at last, complete extinction of it, so that it

cannot be raised above a whisper; at the same time there is usually a feeling as if there was some constant cause of irritation in the throat, attended by a desire to cough up and expectorate. As the disease advances, the expectoration becomes more and more puriform, the cough increases, the patient emaciates, is affected with night-sweats, and at last sinks from what is called laryngeal phthisis. When the posterior nares and the neighboring parts of the pharynx are affected, the symptoms are not so severe, though they may eventually become so by the extension of the disease downwards.

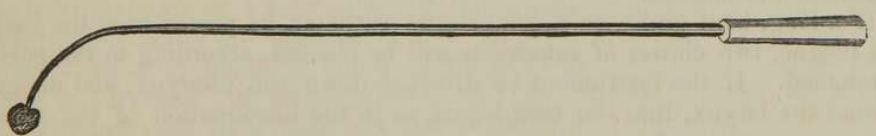
These affections are very frequently mistaken for chronic bronchitic, or catarrhal attacks. From the first they may be distinguished by the absence of all auscultatory signs in the chest, and examination of the pharynx will prevent the disease being confounded with an ordinary catarrh. This examination, however, requires to be properly done, so that a full view may be gained of all the parts engaged in the morbid action. This is best obtained by seating the patient opposite a good light, and then, depressing the root of the tongue at the same time that it is drawn forwards by means of a proper tongue-depressor or spatula, directing the patient to inspire. In order to examine the mucous membrane at the back of the pharynx, and in the neighborhood of the posterior nares, the velum may be raised by any convenient instrument.

The *treatment* of these various chronic inflammations of the mucous membrane of the pharynx and larynx requires to be conducted by the topical application of a solution of the nitrate of silver, which may almost be looked upon as specific in these diseases.

The practice of treating chronic disease of the larynx by the application of a strong solution of the nitrate of silver is by no means of recent origin. Many years ago it was employed by Sir C. Bell, and before him M. Bretonneau applied the solution in these cases by means of a sponge attached to a piece of whalebone. Of late years this practice has been brought very prominently before the profession by Trosseau, and by the American surgeons, especially by Horace Green and J. Warren.

Of the great value of this treatment in laryngeal disease there can be no doubt. I believe it to be almost impossible to bring deeply-seated and very chronic inflammatory or ulcerative affections of this part of the air-passages to a satisfactory termination by any other means. The mode of application that is the simplest and most effectual, consists in depressing the tongue with a proper spatula, and then passing a throat-sponge, consisting of a small piece of this material firmly attached to a curved whalebone stick, and saturated with a solu-

Fig. 292.



tion of nitrate of silver, down to the parts that are diseased, so that the liquid may be applied to the whole of the affected surfaces. This solution should vary in strength from half a drachm to a drachm of the salt to an ounce of distilled water; most commonly, the latter strength will be most useful. This plan of treatment has been much practised of late years in this country, and with considerable success in a large number of cases. Some of its advocates, however, not content with curing in this way disease that is visibly seated in the throat, state that the morbid action extends down the trachea into the bronchi, and that it is necessary to follow it in these situations. They accordingly speak of passing the probang between and beyond the vocal cords, and of sponging and mopping out the interior of the larynx and the lower parts of the air-tube, and of applying the caustic solution to them, as if this were a proceeding that could

be adopted with as little difficulty as passing the sponge into the nares. I cannot believe, however, that this practice, though commonly spoken about and professedly employed, is ever in reality carried out. Any one acquainted with the physiology of the larynx knows how acutely sensitive it is, and how it resists the introduction of any foreign body by the most violently spasmodic fits of coughing, in its normal state; and any surgeon who has seen the effects resulting from the fair and complete inhalation of a drop or two of the solution of the nitrate of silver in a morbid and irritable condition of this tube, must feel sure that no sponge saturated with a solution of this caustic could ever have been thrust down beyond and between the vocal cords.

On inquiring into the evidence on which is founded the doctrine of the passage of the sponge probang through and beyond the vocal cords, I have failed to discover that any of a positive character exists, and so far as I can gather from the writings of its supporters, it would appear that the reasons from which it is inferred to do so may be arranged under the following heads: —

1st. The sensations of the patient.

2d. The sensations of the surgeon.

3d. The analogy offered by the introduction of tubes for the purposes of artificial respiration, and by the inhalation of foreign bodies.

These different conditions we must examine somewhat in detail.

1st. *The sensations of the patient.* — The exquisite degree of sensibility possessed by the larynx need not be dwelt upon here. Mr. Porter in his admirable work "On the Surgical Pathology of the Larynx and Trachea," very justly says, "It (the larynx) is placed as an outwork to protect the important organ of respiration, and rejects vehemently and with spasmodic violence, every substance that can by possibility prove offensive or injurious." Many years ago Magendie shows that this was the most sensitive part of the respiratory tube; and in the year 1843 I published in the "Medical Gazette" a series of experiments, which demonstrated the same fact. Since then I have had repeated opportunities of verifying the correctness of these observations in the human subject in cases of cut-throat and aërial fistula, in which, by means of probes introduced through the artificial opening, I have tested the extreme sensibility of the larynx as compared with other parts of the air-passages, and have often observed the spasmodic irritation and great distress suffered by the patient when its mucous membrane is touched from within, and this, even though the part is no longer subservient to the purposes of respiration, and the sensation of asphyxia not experienced, which would otherwise be induced, and which would greatly aggravate the distress.

If a long, bent probe, or a gum-elastic catheter, be passed over the back of the tongue, two classes of sensations will be elicited, according to the part that is touched. If the instrument be directed down the pharynx, and altogether behind the larynx, into the œsophagus, as in the introduction of the stomach-pump tube, the patient will experience some little distress, which is easily quieted. The face will become slightly congested, and the eyes, perhaps, somewhat suffused, with a disposition to cough, a slight feeling of choking, and some constriction about the chest. All these sensations, however, are transitory. These symptoms may be termed *pharyngeal.*

If, on the other hand, the probe or tube be bent *forwards*, so as to touch the lips of the glottis, and more particularly if an attempt be made to push it on into the larynx, then a widely different train of symptoms will be induced. The patient suffers extreme distress and anxiety; there is great sensation of constriction about the chest and throat, spasmodic difficulty in breathing, and an inability to speak; the countenance becomes much congested and livid, the eyes protrude and stream with tears, he stands up, gropes wildly with his hands, and is pacified with great difficulty. As the attack goes off, there are deep,

sobbing inspirations, and catches in the breathing. These symptoms, which are analogous to those induced by the irritation of the inside of the larynx through an aërial fistula, may be termed *laryngeal.*

The first class of symptoms is produced by the application of an irritant to the mucous membrane of the pharynx; the second, to irritation of the larynx. Their severity will, in a great measure, depend upon the nature of the irritant applied. They will necessarily be far more severe when a sponge soaked in a caustic solution is thrust down the throat, than when a smooth and unirritating gum elastic tube is passed.

Both these classes of symptoms are commonly met with after the application of the throat probang. When the *pharyngeal* symptoms occur, there can be little doubt that no sponge saturated with a strong solution of nitrate of silver has penetrated into the glottis. But is not the case different when the *laryngeal* symptoms are fully developed? Must these not, when existing in their full intensity, be taken as evidence of the introduction of the sponge probang through the glottis? To this I have no hesitation in answering in the negative. I have repeatedly brought on these symptoms, in the most marked degree, without the use of a sponge at all, or the introduction of any solid body into the larynx. In fact, if a drop of a strong solution of the nitrate of silver is fairly *inspired* into the larynx, the most intense distress, and appearance of impending asphyxia will be induced. I saw this well exemplified some time since at the hospital, whilst applying a strong solution of nitrate of silver by means of lint wrapped round a probe to a syphilitic ulcer on the soft palate, altogether away from the larynx; a drop was accidentally inhaled, when the patient was suddenly seized with one of the most intense attacks of laryngeal spasm that I have ever seen; for a few moments she appeared to be about to die asphyxiated, and had all the laryngeal symptoms above described fully marked.

In many cases I am in the habit of applying the solution of the nitrate of silver by means of a strong glass tube bent nearly at right angles about an inch from one extremity. A few drops of the solution are introduced into the ben end of the tube, and this being passed over the back of the patient's tongue, so as to overhang the glottis, the other end is closed by the pressure of the finger. The patient having previously emptied his chest, is then told to take a deep breath, and, at the moment of doing this, the finger being removed from the tube, the solution contained at its bent end is inhaled fairly into the larynx; and, when so applied, will produce the symptoms already described.

Thus, then, we may conclude, that when the *pharyngeal* symptoms exist alone, the sponge cannot have passed into the true air-passages; and that the *laryngeal* symptoms, however intense they may be, afford no evidence of more than the inhalation of a drop or two of the caustic solution into the glottis.

2d. *Sensations of the Surgeon.* — The little reliance that can be placed on the mere sense of touch in many explorations of the mucous canals is well known to surgeons. It often happens, for instance, that in the attempt to relieve retention of urine from enlarged prostate, the catheter is supposed to be lodged in the bladder, when it has only reached the dilated sinus of the urethra: so also in passing bougies up the rectum, that the instrument has entered the sigmoid flexure, when, in reality, it has curled back upon itself. Those practitioners, however, who believe in the possibility of passing the sponge probang beyond the vocal cords, rely much on the sensations communicated by its passage through this narrowed portion of the larynx. They say that in passing the instrument to the proper depth, a certain sense of obstruction is felt; against this, which is believed to be the vocal cords, the sponge is firmly pressed for a moment, when the obstacle yields, and the instrument passes onwards into the air-tubes. On the withdrawal of the probang, the same feeling of constriction is experienced by the sponge being drawn up against the cords. These sensations are undoubtedly experienced. I have many times

felt them myself, and, had I judged by them alone, could have been almost certain that I had passed the instrument between and below the vocal cords, and this belief would have been strengthened by the circumstance that in many of the instances in which this constriction was felt the *laryngeal* symptoms were manifested. I soon found, however, that this was by no means uniformly the case, but that it not unfrequently happened that the *pharyngeal* symptoms only were induced; and that consequently, in accordance with what I believed to be the proper state of sensibility of the larynx, the interior of that tube could not have been traversed by the caustic sponge. Finding also the same sensation often experienced in the introduction of bougies and tubes into the œsophagus and stomach, it was clear that it could have nothing to do with their progress through the larynx; and I was led to conclude that it was occasioned by the passage of the instrument through that narrowed portion of the end of the pharynx, or the beginning of the œsophagus, where the cartilages of the larynx, projecting backwards, give rise to a certain amount of constriction, compressing the gullet, as it were, against the spine. Here the instrument meets with a certain degree of obstruction, which is partly mechanical and partly occasioned by spasm of constrictors of the pharynx, and, on this being overcome, passes on with a sudden slip, again to meet with a degree of constriction on being withdrawn.

In numerous experiments on the dead body that I have made on this point, I have very frequently found that the instrument had passed into the œsophagus, when, from the sensation it gave, those who had introduced it felt confident that it had entered the air-passages. In fact, the shape of the sponge probang, as it is always sold (fig. 292), is such that it cannot be made to enter the larynx, and to pass beyond the vocal cords in the dead body, without the employment of a considerable degree of force, and by means of those manipulations which are alone admissible in the living patient. A probang, with a short curve, such as those that are uniformly employed, has a natural tendency to take the direct passage, as it were, down the œsophagus, instead of turning forwards to enter the larynx. When the curve is much increased, as in an ordinary catheter, the sponge may, during life, be passed between the lips of the glottis, but it cannot even then be made to pass between and below the vocal cords, in consequence of the curve being too large to be admitted into the diameter of the trachea. The evidence of the New York Academy Commission fully warrants this statement; for the reporters remark, that notwithstanding the most persevering efforts with the whalebone slightly bent, as used by Dr. Green, and with patients who quietly submitted to the test of experiment, the results were entirely negative. In no instance did it enter the trachea. In two instances, with the whalebone *curved like a common catheter*, the sponge was thought to have entered the larynx, but with repeated attempts it could not be forced between the vocal cords, and the suffocation was so great that it was necessary to withdraw the instrument.

The fallacy of the sensations of the surgeon is well illustrated in the following extract from the report of the Commission of the New York Academy: — "We witnessed in cases 11 and 21 the fallacy of Dr. Green's opinion as to the success of his experiment, though based on so large an experience. In both instances, whilst positive that he had successfully passed the instrument (an elastic tube) into the trachea, *the patient vomited through the tube*, and thus demonstrated his error."

From these observations, then, I would conclude that the sensations of the surgeon afford no reliable evidence as to the course taken by the instrument.

3d. In asserting that the sponge probang can be passed into the air-passages, much reliance has been placed on the analogy afforded by the introduction of tubes for the purpose of artificial respiration, and in the occasional inhalation of foreign bodies. Does any such analogy really exist? I think not. It

seems to me that so very different a degree of irritation would be set up by the introduction of a smooth, well-oiled tube of small calibre, through which the patient can breathe, and from which consequently there is no risk of suffocation, and the passage of a caustic sponge, which not only would stimulate the part violently, but would necessarily induce temporary asphyxia by blocking up mechanically the air-passage, that no analogy can be drawn from the one case to the other. To do so, seems about as reasonable as to infer, that because a gum-elastic or silver cathèter may be passed along the urethra, therefore a whalebone rod, tipped with a sponge soaked in a caustic liquid, might also be introduced into the bladder.

With regard to the introduction of foreign bodies into the larynx, it appears to me that there is no analogy whatever between this accident and the passage of the caustic sponge. In the one case, the parts are taken by surprise, the foreign body being accidentally sucked into the chest by a rush of air, during inspiration, through an open glottis. In the other case, the patient is prepared for what is about to take place, involuntarily and instinctively resists, and, holding his breath, keeps the glottis closed.

But setting aside this question of analogy, which is of little moment, is the introduction of tubes, even into the larynx so very easy and simple and certain a procedure as some writers seem to suppose it to be? On the dead body, undoubtedly nothing is easier than to pass a catheter into the larynx, and down into either bronchus; but is it so in the living? That excellent surgeon, Mr. Porter, of Dublin, when speaking of the introduction of Desault's tubes through the rima glottidis, in cases of cut-throat, says: "Awkward and reiterated attempts produce inconceivable distress, and even when performed with the utmost dexterity, it must unavoidably excite cough and restlessness." And again: "Every time the instrument touches the larynx, the patient becomes anxious and restless; he tosses himself about, and coughs convulsively; and each motion, whilst it increases his own distress, renders the performance of the operation more difficult. . . . . Can such a patient endure the irritation that a few moments' unsuccessful poking at the rima glottidis will inevitably occasion?" The truth of these remarks must be acquiesced in by every surgeon who has ever attempted the operation there described.

On this point, the evidence of the New York Academy Commission is peculiarly valuable. That Commission, in its inquiry, employed two tubes, the size of a No. 10 catheter: one, selected by Dr. Green, was slightly bent at its extremity, and was one of the kind employed by him in his practice. The other consisted of a catheter with a wire stilette, bent with a curve, the segment of a circle six inches in diameter. This tube does not appear to be used in practice, but was employed for the purpose of comparison. The result of the experiments with these tubes was, that Dr. Green (who was the only one that employed it) failed in passing the tube with the *small* curve in thirty-five out of thirty-eight trials, or in about ninety-two per cent. of the cases; and that the tube with the *large* curve was passed in eight cases out of thirteen; whilst the sponge probang failed in every case (eighteen) in which it was tried.

"From these experiments it would appear that the instrument best adapted to succeed in catheterism of the air-passages is the tube having a large curve; whilst the least adapted to enter the trachea is the sponge probang."

In the course of these experiments a point of much interest was elicited by the Commission,—viz., that a patient might blow out a lighted candle, or collapse and inflate a bladder attached to its free extremity, through the tube, even though it had never entered the trachea, but had been purposely passed into the œsophagus.

On this third point, then, I think we are warranted in the conclusion that there is not sufficient analogy between the introduction of the sponge probang and that of a catheter tube into the larynx, to lead us to suppose the passage of

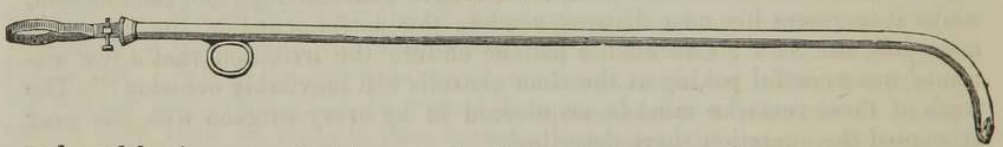
the former instrument possible, because that of the latter is occasionally practicable; and that the introduction even of a tube of the same shape as the sponge probang is an operation of extreme difficulty, failing in far the greater proportion of cases in which it has been attempted; and that the introduction of foreign bodies into the larynx is effected under totally different conditions to that in which the sponge is attempted to be passed.

Finally, I think that we are fully justified in adopting the conclusion of the Commission of the New York Academy, that there is no reliable evidence that the sponge probang has ever been passed through and beyond the vocal cords.

The inhalation of the nitrate of silver in powder is most conveniently done by mixing it, in proper proportions, with some innocuous, impalpable powder, such as ground and dried sugar. The strength may vary from one part of the nitrate of silver to twelve, sixteen, or twenty of the sugar. A small quantity of the powder so prepared should be put into the end of a thick glass tube, which has been bent nearly at right angles, about one inch from its extremity. The surgeon, placing his finger over the orifice of the straight part of the tube, carries the bent end behind the tongue, over the epiglottis; he then directs the patient to make a sudden inspiration, and at the moment of his doing so takes away his thumb, so as to allow the powder to be drawn out of the tube and into the air-passages along with the current of inspired air. In this way the nitrate of silver may, in some cases, be very conveniently applied to the whole of the affected mucous surfaces without the irritation produced by the friction of the sponge.

The injection of the solution of the nitrate of silver may easily be done by means of the instrument that is here delineated (fig. 293), and which I have had constructed for this purpose. It consists of a silver tube, perforated at the

Fig. 293.



end, and having a small piston moving in it with a sponge attached to its lower surface. The instrument is charged by dipping the end in the solution, and then drawing back the piston-rod. It is then passed into the pharynx, or between the lips of the glottis, and the fluid injected into the air-passages or upon the inflamed surfaces in a number of fine streams, by pushing down the piston and compressing the sponge. By means of this *laryngeal syringe* the nitrate of silver can be applied to any part of the pharynx, without irritating the tender mucous membrane by the contact of a rough body, and by applying its nozzle to or between the lips of the glottis, the fluid may be readily thrown down into the interior of the larynx with the greatest certainty and ease. In those cases in which it is wished to apply the solution of the nitrate of silver into the air-passages, I far prefer using this simple instrument to the ordinary sponge, the mere pressure of which upon a tender mucous surface may be a source of irritation. When the mucous membrane behind the velum, or of the posterior nares is affected, the solution may readily be injected against these parts by turning the end of the instrument upwards, and then injecting it directly on to the affected surfaces. In whatever way the caustic is used, its application should be repeated about every second or third day, in order to insure its full effects In some instances, however, advantages may be obtained by using it every day; in others, again, a longer interval is required than that just stated.

In the more advanced forms of chronic disease of the larynx, the mucous membrane becomes infiltrated with plastic deposits, which also form upon its surface in the shape of vegetations, and at last run into ulceration, with much

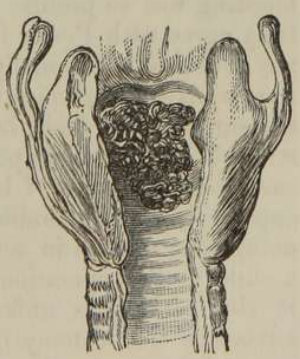
narrowing of the rima and muco-puriform discharge. These diseases are often of a syphilitic origin, and after continuing for some length of time give rise to hoarseness, cough, shortness of breath, a pale, pasty and œdematous look about the face, with suffused eyes and constant difficulty in breathing. Under these circumstances there is a constant tendency to acute inflammation supervening on the chronic laryngeal disease, and the affection commonly proves fatal by the induction of œdema glottidis, often coming on with great rapidity.

Necrosis of the cartilages of the larynx not unfrequently happens in the more advanced forms of this affection, attended with all the signs, constitutional and local, of the so-called *laryngeal phthisis*, and by the expectoration of large quantities of fetid puriform sputa, often streaked with blood, and occasionally containing masses of the necrosed and disintegrated cartilage. In many cases abscesses form outside the tube, and after much irritation and distress open externally, and not unfrequently they are met with to such an extent as to undermine and disorganize the greater portion of the tissues of the anterior part of the neck. Where they correspond to the necrosed patches of cartilage they give rise to aërial fistula, through which bubbles of air escape during respiration.

In the *treatment* of these more severe diseases of the larynx, the daily application of nitrate of silver will be found of great benefit. It should be freely applied to, or injected upon the mucous membrane about the epiglottis, within the lips of the glottis, and more especially that loose and filamentous tissue which is extended over the back of the thyroid cartilage, and which is commonly the seat of much chronic irritation, and the chief source of the muco-puriform discharge. At the same time the internal administration of the bichloride of mercury with sarsaparilla will often be found of great service, more particularly in those cases in which the disease is of a syphilitic character; the patient being kept in a regulated temperature, not allowed to exert his voice, and avoiding all laborious exertion. Whenever acute inflammation supervenes in these cases, with a tendency to œdema about the glottis, the patient should be narrowly watched, as he may readily be carried off by the sudden swelling of the lips of the rima, or the supervention of spasm. In such cases as these, the air-passages may require to be opened to allow of respiration to be carried on, and this operation must not be delayed until such time as the patient falls into an asphyxial condition.

Nervous affections of the larynx occur both in children and adults. In children this affection, commonly called *spasmodic croup*, comes on suddenly and runs its course with great rapidity. The child is seized, often without previous warning, with difficulty in breathing, uses violent efforts to inspire, becomes black in the face and convulsed, and may die before anything can be done for his relief. In other instances again he gapes and gasps a few times, and eventually recovers himself with a long deep-drawn whooping inspiration. In such cases as these, the treatment at the time of the fits consists in dashing cold water in the face, in exposing the body to a current of cold air, and in using friction to the extremities. If asphyxia occur, artificial respiration must be kept up either through an opening made in the windpipe or by the mouth.

Fig. 294.



In the adult, these spasmodic affections of the larynx may come on either from pure hysteria, or from irritation of the laryngeal nerves by the pressure of tumors or aneurisms upon them. In other instances again they appear to arise from the presence of some local inflammatory mischief about the glottis. In the hysterical form of the affection the ordinary remedies for hysteria, together with cold douches, will be of essential service

In some cases, however, the obstruction to respiration is so great, that the surgeon may almost think it necessary to have recourse to operation. When the disease arises from irritation to the trunks of the nerves, such a procedure is seldom justifiable, as the occasioning cause is usually in itself of a fatal character.

Tumors or *polypi* occasionally form in the larynx. They are commonly granular, or small cauliflower-looking bodies, though they occasionally attain the size of a hazel-nut (fig. 294). They necessarily interfere with respiration, and at last may give rise to asphyxia by obstructing the cavity of the larynx.

OPERATIONS ON THE WINDPIPE.

The windpipe may require to be opened either to allow of the formation of a temporary breathing aperture, in consequence of the obstruction of the larynx from causes that are speedily removable; or, the air-passages may require to have a permanent aperture established in them in those forms of chronic laryngeal disease, in which the obstruction depends upon such organic alterations of structure as are not remediable. Amongst the conditions that require the temporary opening of these passages may be mentioned, all acute inflammatory affections of the larynx, together with the various nervous or spasmodic diseases of this organ; so also certain traumatic conditions may require this operation, as the impaction of masses of food in the gullet inducing asphyxia and not admitting of immediate removal, the presence of foreign bodies in the air-passages, and œdema of the glottis from wounds of the thyro-hyoid membrane.

The establishment of a permanent aperture in the air-passages is especially required in chronic diseases of the larynx, attended by thickening of the mucous membrane, abscess, or necrosis of the cartilages, and in fact such conditions as do not admit of removal; so also in polypi of the larynx a permanent opening below the obstructed point may be required.

It is a question whether the windpipe should be opened in cases of croup. Were croup merely a disease of the larynx it would doubtless be proper to perform the operation; but it has been incontestably shown that in this affection when it is severe, the inflammation is not confined to the larynx, but usually extends down the bronchi even to the lungs, which become engorged and affected, so that death very commonly results from this cause, as much or more than from the laryngeal disease. Hence opening the trachea alone will not suffice in saving life in the majority of instances, as the child will ultimately die of broncho-pneumonia. In this respect, the result of tracheotomy in croup differs remarkably from that of the same operation for acute laryngitis in the adult. A serious objection also to the performance of this operation in croup is the difficulty attending it; the struggles and screams of the child, by increasing the tendency to spasm, interfere materially with the surgeon's attempt to open the windpipe. Indeed I have known more than one case in which the bleeding was so profuse as to prove fatal. But although, as a general rule, I fully agree with Porter in strongly reprobating this practice in croup, yet cases are doubtless occasionally met with, in which the disease is so clearly limited to the larynx—the respiration being free throughout the lungs and bronchi—that the surgeon may feel himself justified in endeavoring to save the little patient, struggling against overpowering asphyxia, by opening his windpipe. In several such cases, to which I have been called by other practitioners, and which were apparently most favorable to the operation, I have considered myself justified in doing this, though in no instance have I as yet succeeded in eventually saving a child by this operation; and I think that the general experience of surgeons in this country is unfavorable to its performance. Trousseau, who strongly advocates tracheotomy in croup, has, however, published a large number of successful cases in favor of this proceeding. But even in Paris it is not a very successful procedure; thus it appears that at the Hospital for Sick Children in

that city, the operation has been performed 215 times in the last five years, and that of these only 47 were cured. Unless we assume that the disease, as occurring in Paris, is different from the form of croup we meet with here, I think it may fairly be doubted whether an operation could be necessary in many of these instances, and whether a large proportion of the children might not have recovered under ordinary medical treatment.

When it has been determined to open the windpipe for acute disease, more especially supervening on chronic laryngitis, the less delay there is in having recourse to operation the better, as the patient may at any moment be seized with laryngeal spasm, and be carried off. The operation ought always, however, to be completed, even though the patient has apparently expired before the windpipe has been opened, for resuscitation may, even in these extreme cases, be effected by artificial respiration. When life hangs on so slender a thread as it does in urgent cases of laryngeal obstruction, the first touch of the knife may cause a spasmodic seizure that may give rise to apparent death. It has twice happened to me to operate under such circumstances, and in both cases to be fortunate enough to save the patient's life. In one case to which I was called about five years ago by my friend Mr. E. Baker, the patient, an elderly woman, was apparently dying from the supervention of acute upon chronic laryngeal disease. I lost no time in making an incision into the crico-thyroid membrane, but at the first touch of the knife she sunk back apparently dead. I immediately completed the operation, and introduced a large silver tube, through which the lungs were inflated, when, in the course of a few minutes, the action of the heart recommenced, and the patient eventually recovered. She has never, however, been able to breathe without the silver tube, which she wears in her windpipe up to the present time. In another case to which I was hastily summoned by my friend Mr. Tweed, I found the patient, a young woman, in the last stage of asphyxia from acute disease of the larynx. I immediately proceeded to operate, with the assistance of my then house-surgeon, Mr. Lister. As the patient's neck was short and thick, and the veins excessively turgid, there was profuse hemorrhage on the first incisions being made; whilst waiting a minute or two until this would cease before opening the windpipe, the patient fell back and apparently expired. I lost no time in plunging the scalpel into the crico-thyroid membrane, and cutting down through the cricoid cartilage, so as to make a free aperture into the air-passages. On endeavoring to set up artificial respiration, I found the chest clogged with inspissated mucus, which prevented the entrance of air into the lungs; the life of a fellow-creature being at stake, and dependent on the immediate and full establishment of artificial respiration, I felt there was only one thing to be done, and that was to empty the chest of the matters that loaded it, and that this must be done instantaneously. I accordingly applied my lips to the wound and sucked out three or more mouthfuls of blood and mucus, when I had the satisfaction to see that air could be got to enter the lungs. By keeping up artificial respiration for some time, the heart began feebly to act, the face to become less livid, and the circulation to be re-established; the patient eventually did well, and is now alive and in good health.

In opening the windpipe, the surgeon has the choice of two situations, in which he may make the aperture, — either in the crico-thyroid membrane by *laryngotomy*, or in some part of the trachea by *tracheotomy*. Besides these two established operations, some surgeons have performed a third, — *laryngo-tracheotomy*, by opening the membrane and dividing the cricoid cartilage with the upper rings of the trachea.

Whichever operation is performed, so soon as the windpipe is opened, the patient is seized with an attack of spasm and convulsive cough, often attended by much struggling and distress, during which the whistling occasioned by the passage of the air through the new passage is very loud and marked. The

patient, however, soon recovers himself, and then breathes naturally and easily, the signs of asphyxia disappearing.

Laryngotomy is an easy operation, the crico-thyroid membrane is almost superficial, and may readily be reached by making a vertical incision in the mesial line, between the sterno-thyroid muscles, about an inch in length, and then a cross cut through the membrane with an ordinary scalpel. The air-passage having thus been opened, a silver tube, curved on the flat, may be readily introduced and retained by tapes round the neck. The only troublesome result that can occur in this operation is the wound of a small arterial branch, the inferior laryngeal, that crosses the membrane. I have never seen any trouble arise from this, but should it occur the hemorrhage would readily be arrested by pressure or ligature.

Tracheotomy consists in making an opening into some part of the trachea, by exposing the tube and cutting across one or more of its rings.

In performing tracheotomy the patient's shoulders should be supported with pillows, and his head be thrown as much back as practicable. An incision about an inch and a half in length should then be made with a scalpel directly in the mesial line from the cricoid cartilage downwards. After dividing the integuments, any veins that present themselves should be avoided as carefully as possible, being held aside with a blunt hook. By using the point of the scalpel to a limited extent, and dilating the deeper portions of the incision with its handle or with a director, the trachea may be reached with safety; it must then be opened by pushing the point of the knife, with its back turned towards the sternum, between two of the rings, and cutting upwards, through about three of them (fig. 295). The tube must then be introduced and retained by tapes round the neck.

This operation is often attended by extreme difficulty, and not unfrequently with a considerable amount of danger. The difficulty in exposing the tube increases greatly as the incisions approach the sternum, and are far greater in stout short-necked persons than in those of a different development.

There are three situations in which the trachea may be opened, either above, underneath, or below the isthmus of the thyroid body, which usually crosses the air-tube opposite its third or fourth ring. Above the isthmus, the trachea is comparatively superficial, and is not covered by any venous plexus, nor does any other source of difficulty present itself to the surgeon. Where the isthmus crosses the trachea, this tube is overlaid by a venous plexus as well as by the glandular structure. Below the thyroid gland, the air-tube is overlapped by the sterno-hyoid and sterno-thyroid muscles and by the inferior thyroid veins, which are of large size, together with some tracheal branches from the inferior thyroid artery; and not unfrequently an irregular arterial branch ascends in this situation in front of the trachea to supply the thyroid body. The carotid arteries also are in close relation to the vessel on either side, and opposite the episternal notch it is crossed by the left carotid and by the innominata, which vessel has been seen by Mr. Macilwain to cross the tube at the very point where tracheotomy is usually performed. A glance at these important relations will suffice to indicate the difficulty that must, in many cases, occur in exposing and opening the trachea. This difficulty is greatly increased when the veins of the neck have become turgid in consequence of the pulmonic obstruction. It will also be seen that the trachea is less covered, and may consequently be much more readily reached above, than below the isthmus of the thyroid gland; and though some surgeons, as Velpeau for instance, have recommended the opening to be made in the lower part of the tube, the greater number advise that it should be entered in its upper part, though the incision may, if necessary, be carried downwards as low as, or even through the isthmus.

The difficulties occurring in tracheotomy are chiefly referable to three causes;

1st, the risk of profuse hemorrhage; 2d, the difficulty in opening the air-passage; and 3d, trouble in introducing the trachea-tube.

1st. The hemorrhage in this operation may occur either from arteries, veins, or the thyroid gland. Arterial hemorrhage is less frequent and troublesome than the bleeding from other sources. When it occurs it chiefly happens from the wound of some anomalous branch, or from that of the small tracheal vessels. Desault has however mentioned a fatal case in which death arose from a wound of the carotid. The arterial anastomosis of the isthmus of the thyroid body may, if this part be enlarged, occasion some difficuly in the performance of the operation, but the main source of danger unquestionably proceeds from the venous bleeding Not only are the plexuses of veins of large size, more particularly where they cover the lower part of the trachea, but as has already been observed they become immensely gorged by the asphyxia that necessitates the operation. Hence, when wounded, the bleeding may be so abundant as scarcely to be controllable, and may retard very greatly the after-steps of the operation. Many surgeons of authority in these matters, advise that the windpipe should not be opened so long as the bleeding is abundant, lest the blood entering the bronchi and lungs through the aperture, asphyxiate the patient. I think, however, that in many cases the best way to arrest this hemorrhage is by opening the trachea, and thus enabling respiration to go on, for as the lungs unload themselves the bleeding will cease.

2d. Another difficulty in tracheotomy sometimes consists in opening the tube after it is exposed. In consequence of the convulsive breathing of the patient, the sterno-mastoids are put upon the stretch, thus increasing considerably the depth of the wound in the neck, and at each short and gasping respiration, the air-tube is rapidly pumped or jerked to and fro, approaching to and receding from the surface in such a way that the scalpel cannot be thrust into it with safety. In order to do this with the least risk, a sharp pointed hook should be passed between two of the rings, and the tube being thus fixed, opened by cutting upwards (fig. 295). Or the hook being grooved along its convexity, as

Fig. 295.

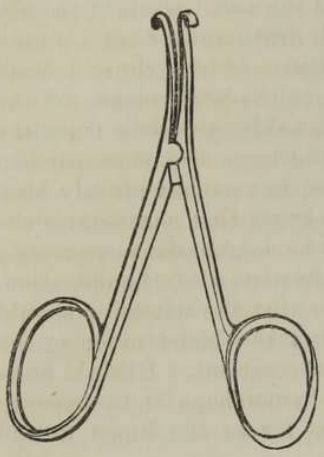
Chassaignac recommends, is to be introduced under the cricoid cartilage, the air-tube pulled up and opened by sliding the scalpel along the groove of this hook-

Fig. 296.

director. I have found it advantageous in some cases to open the trachea with a cutting-hook, such as is here represented (fig. 296). By means of an instru-

ment of this kind, the trachea is first fixed and then divided without danger to the patient. The danger from hemorrhage, and the difficulty in opening the trachea, are much greater in children than in adults. Before the age of puberty, this tube is deeply seated, covered with a quantity of loose granular fat, containing many veins, and is of small size, so that a slight deviation of the incision to one side or the other may readily lead the surgeon astray, and into dangerous proximity with the carotid artery.

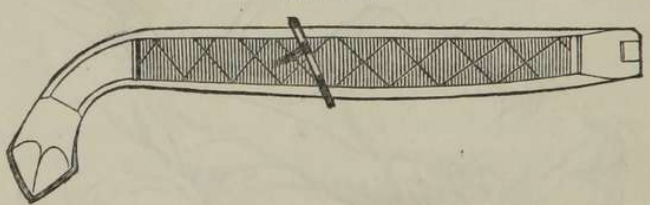
Fig. 297.



3d. After the trachea has been opened, the next point is to introduce, in cases requiring it, a proper tube. In the first instance, one of a conical shape should be employed, as it is not only introduced more readily than a cylindrical one, but fills up completely the aperture in the trachea, so as to prevent the draining of blood into the lungs. In passing the tube, some little difficulty may occasionally be experienced, owing to the elasticity of the sides of the incision in the windpipe, in consequence of which one of them is apt to get doubled under the end of the instrument. This may be avoided by the use of Dr. Fuller's bivalve tube introduced closed, and then expanded by slipping a canula into it; or one side of the cut in the trachea may be held aside with the forceps or a blunt hook, whilst the tube is slipt under the other. If the rings of the trachea are very rigid and unyielding, the silver tube may most conveniently be introduced by expanding the incision by means of the trachea-forceps (fig. 297), and then passing the tube between or under their blades.

My friend and colleague, Mr. H. Thompson, has recommended a very simple and most ingenious mode of opening the trachea, by which the dangers and difficulties of the old operation, such as have just been described, are in a great measure avoided. This operation consists in making the puncture at once into the windpipe by means of the tracheotome as here depicted (fig. 298), which

Fig. 298.



serves at the same time as a guide to the tube into the opening. By means of this instrument a puncture is made *transversely* through the skin and cellular tissue, and between the first and second rings of the trachea, so that the cartilages are not injured. When the blades have been introduced they should be held there by the left hand, and the screw in the handle gradually turned, so that the separation of the blades may dilate the contiguous structures until the aperture is sufficiently large to allow a tube to be introduced.

Mr. Thompson states that the proper point for introducing the instrument may always be determined by feeling for the projection of the cricoid cartilage, and defining its lower border clearly with the finger. The point of the instrument should then be introduced transversely in the mesial line a quarter of an inch below this cartilage, when it will enter the space between the first and second rings. The screw is then to be turned, the blades expanded, and the tube introduced, as above described. This operation is certainly one of the

safest, easiest, and most speedy modes of opening the trachea, and appears to be a very great improvement upon the ordinary methods of performing tracheotomy. It is not, however, applicable to children, nor would it, I think, be desirable to have recourse to it in those cases in which the trachea requires to be opened for the extraction of foreign bodies from the windpipe, as the vertical incision tends to facilitate their escape.

On comparing tracheotomy as ordinarily performed, with laryngotomy, I think there can be little doubt that the surgeon should give the preference, in all cases where it is practicable, to the latter operation, on account of its greater simplicity, safety, and rapidity, though in these respects it appears to be equalled by the method introduced by Mr. Thompson. In all those cases in which the obstruction to respiration is dependent upon inflammatory effusions into the submucous cellular tissue, whether it be dependent upon idiopathic or erysipelatous laryngitis, or upon the irritation and inflammation excited by swallowing boiling water or the stronger acids, the swelling, for reasons that have already been mentioned, never extends below the true vocal cords; hence an opening into the crico-thyroid membrane will always be below the seat of obstruction. An objection it is true has been urged to laryngotomy in these cases, that it does not allow of the patient wearing a tube without much irritation being induced. This, however, I have not found to be the case in my practice. I have at present two patients under observation, in both of whom I introduced a silver tube in this situation a considerable time back, and in whom no special irritation has been occasioned by it. In one case the tube has been worn for eight, and in the other for nearly five years; the larynx in both instances having been nearly completely occluded by chronic disease. When the windpipe requires to be opened for the extraction of a foreign body, tracheotomy should be performed in preference to laryngotomy, as the latter operation does not admit of sufficient space for its expulsion or extraction.

In children, tracheotomy is almost always a tedious and often a dangerous operation, the exposure of the trachea requiring very careful dissection, and much time being often lost before it can be punctured, owing to the free hemorrhage which usually occurs.

In my opinion, laryngotomy is the operation that should, as a general rule, be preferred, and this opinion is based on the following reasons: —

1st. That as in laryngotomy the air-tube is always opened below the seat of obstruction, there can be no necessity to make an aperture further from the seat of disease. In laryngitis, whether that affection assume the acute or chronic character, the obstruction in breathing is in a great measure mechanical, and dependent upon the infiltration of the submucous cellular tissue of the larynx, and partly of the large plane of this tissue, which lies behind the box of the larynx, and which, by expanding, as it were, into the pharynx, obstructs deglutition, and afterwards, by the extension of this swelling and infiltration to the lips of the glottis and the interior of the larynx, causing an impediment to the entrance of air into the bronchi. But, as has been pointed out by Mr. Prescott Hewett, this submucous cellular tissue terminates at the true vocal cords, where the mucous membrane becomes directly applied to the subjacent fibrous structures, the swelling and consequent mechanical impediment is confined to the limits of the thyroid cartilage, and any opening made below this will clear the lowest limit of the disease, which is always accurately and almost mathematically bounded below by the vocal cords. Hence an aperture in the crico-thyroid membrane is quite as effectual as one in the trachea.

2d. Laryngotomy is a far safer operation than tracheotomy. On this point I need scarcely dwell; a glance at the anatomy of the parts concerned will be sufficient to establish it. The crico-thyroid membrane is nearly subcutaneous, and no parts of importance can be wounded in opening it, if we except the small inferior laryngeal artery, which crosses it, and which might be cut across,

but from which I have never seen any trouble arise. The trachea, on the contrary, is not only deeply seated, but covered by a large plexus of blood-vessels, which, when rendered turgid by the asphyxiated condition that exists when these operations are required, pours out a large quantity of dark blood, and thus seriously embarrasses and delays the surgeon at a time when the life of the patient depends on the speedy admission of air to his lungs.

3d. Laryngotomy can be much more quickly performed than tracheotomy. This I look upon as an inestimable advantage in many of the cases requiring operation; a few seconds, more or less, being sufficient to turn the balance either in favor of life or of death. The rapidity with which laryngeal obstruction — partly mechanical and partly from spasm — sets in, is sometimes so great, more particularly when an acute inflammation supervenes on chronic disease of the larynx, that life may be extinguished before the surgeon has time to open the windpipe, if he endeavors to do so by tracheotomy. In extreme cases, such as where the lungs have become slowly engorged, the action of the heart is already enfeebled, and a sudden spasm occurring at the glottis, will at once place the patient beyond recovery. But even though life appears for the moment extinct, it is the imperative duty of the surgeon to open the air-passages as speedily as possible, and to endeavor, by means of artificial respiration, to recall the flickering spark; and it is impossible to experience a greater satisfaction in the exercise of our profession, or to witness a greater triumph of art, than in thus snatching a patient out of the very jaws of death.

It is a practice with some surgeons not to open the windpipe until all, or nearly all, the bleeding has ceased. But in this way much valuable time may be consumed, and the patient may be fatally exhausted by a tedious and prolonged operation, and by the loss of an unnecessarily large quantity of blood. The hemorrhage in these operations is almost entirely of a venous character, and is, in a great measure, dependent on the distension of the veins of the neck that occurs in asphyxia, as the result of the accumulation of blood in the right cavities of the heart, consequent upon the obstructed circulation through the lungs; and the bleeding will continue so long as that obstruction remains unremoved. But as the respiratory process is re-established, this obstruction to the pulmonic circulation diminishes, the cardiac cavities become unloaded, the venous turgescence of the neck subsides, and the hemorrhage proportionately lessens. This I have repeatedly found in asphyxia artificially induced in animals, and have more than once seen in the human subject in cases in which it has become necessary to open the windpipe at once, without waiting to arrest hemorrhage. Hence, except in those instances in which an arterial twig or large venous trunk has been wounded, and which must, of course, be secured, the occurrence of bleeding, though tolerably smart, need not deter the surgeon from opening the windpipe; as the relief afforded to respiration will induce a corresponding and rapid dimunition in the venous turgescence of the neck, and in the consequent flow of blood from the wound.

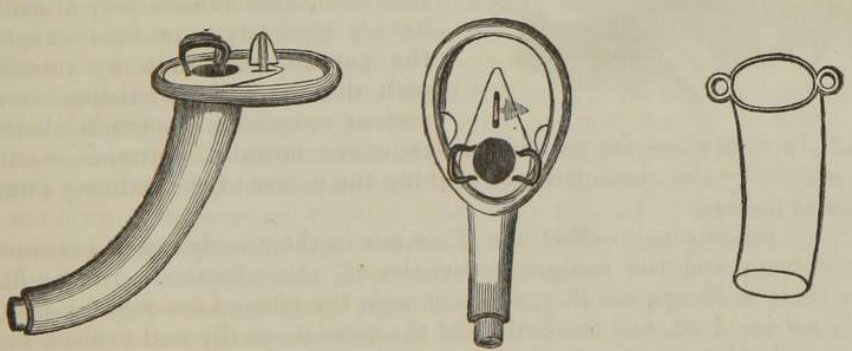
Trachea-tubes should be of such a calibre throughout as to admit of respiration being carried on through them without any effort on the part of the patient. Many of those that are to be met with in the instrument-makers' shops, though very wide at the mouth, are far too narrow and contracted at the lower aperture to allow a free and unimpeded passage for the air of respiration, being made very conical in order to admit of easy introduction, and to occlude completely the opening in the windpipe, so as to prevent the entry of any blood by the side of the tube. The disadvantage attending this mode of construction may in a great degree be remedied, by having a longitudinal opening like the large eye of a catheter cut in the side of the tube, immediately above the inferior aperture.

One great difficulty that the surgeon has to meet in cases of tracheotomy or laryngotomy is to keep the tube from being clogged and obstructed by mucus.

It is usually stated that the tube may be kept clear by the occasional introduction of a feather, of a piece of sponge fixed to a stick, or a bit of lint wrapped round a probe. In this way it is true that the frothy or spumous mucus that collects in the tube may be readily enough cleared away; but this simple means will in very many cases be found to be quite ineffectual in removing another kind of mucus that in certain conditions rapidly accumulates to a considerable extent within the tube. On examining a trachea-tube that has been worn for but a few hours, it will be found that its interior becomes gradually lined by a coating of dry, gummy, and very tenacious mucus, which is so firmly adherent to the metal as to render it necessary, before the tube can be properly cleaned, to detach this lining by means of a penknife or pointed probe; or, what is better, by pouring boiling water through the tube. This tenacious mucus, collecting, as it does, in largest quantity at the inferior aperture, and at the curve of the trachea-tube, may block up its calibre to a very great and dangerous extent, whilst the mouth of the tube appears to be perfectly pervious and free, and though feathers and pieces of stick, armed with sponge or lint, have been introduced from time to time; but these, passing over this dry mucus, are quite unable to detach it from the side of the tube, and merely bring away the sputa and more frothy mucus.

Mr. Obré has devised a very simple means to remedy this inconvenience. It consists in the trachea-tube being made of uniform calibre throughout, and having an interior tube accurately fitted to it, and projecting about one-eighth of an inch beyond the lower extremity of the outer tube. It is in the projection of the internal tube beyond the lower end of the external one that the great utility of this contrivance consists. If the two tubes are of the same length, or still more, if the innermost tube be the shorter, a plug of mucus may be left at the end of the outer canula, on the withdrawal of the inner tube. But if this be the longer of the two, the end of the outer tube will be effectually cleared every time it is withdrawn, which may be done as often as any mucus collects, without in the slightest degree disturbing the patient. The two tubes are

Fig. 299. Fig. 300. Fig. 301.



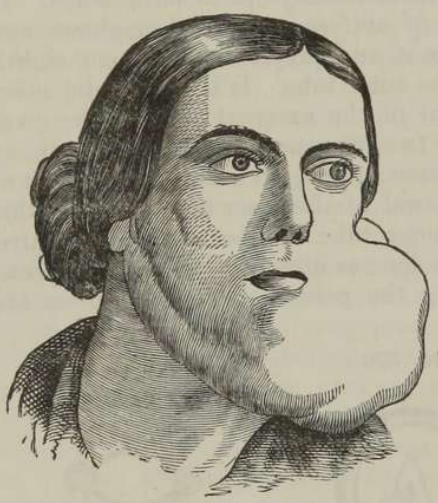
fixed by means of a button, attached to the edge of the outer one (figs. 299, 300). I have found it convenient to have the ordinary set of three trachea-tubes made in this way, the internal tube being the largest, the middle the next in length, and the external the shortest. By this arrangement the smaller trachea-tube is made to serve the purpose of the internal canula. When used for laryngotomy, these may conveniently be curved on the flat (fig. 301), their longest diameter being lateral instead of antero-posterior, thus adapting themselves to the form of the aperture in the crico-thyroid membrane.

DISEASES OF THE PAROTID.

Parotitis or *mumps* is a common affection, especially in children, though it not unfrequently occurs in adults. It usually arises from cold and wet, and is frequently infectious. Both sides of the neck are usually affected, and the swelling, stiffness, and pain are often considerable, though it very rarely happens that suppuration occurs unless it be in the lymphatic glands of the neighborhood. Metastasis, though of rare occurrence, has been described as occasionally happening to the testicle or breast. The treatment for this affection is of a simple character, the application of hot fomentations and leeches if it be severe; the administration of saline purgatives, and, as the affection is on the decline, frictions with camphorated oil will hasten its resolution.

Tumors of the parotid itself are not so frequent as morbid growths situated upon or in the vicinity of this gland, yet occasionally they occur either upon it, or consist in an actual transformation of its structure. The tumors usually met with here are of a fibrous nature and often encysted; they are hard, deeply attached, but yet movable on careful manipulation; round, and often attain a very great size, up to that of a cocoa-nut even (fig. 302); the skin covering them is thin but not adherent, and not unfrequently a net-work of veins covers the mass. These growths frequently send prolongations under the lower jaw, and then occupy the whole of the space between its angle and the mastoid process; when firmly bound down, they involve the blood-vessels and nerves in this important region, coming into relation with the styloid process and its muscles, and even pressing upon the pharynx. In consequence of the large size that these tumors may attain they have a tendency to produce atrophy of the parotid, and often by interfering with the cerebral circulation occasion various congestive symptoms about the brain. In some cases the parotid may undergo cancerous infiltration, the tumor then presenting the characters and running the course of the ordinary forms of malignant disease.

Fig. 302.



It is of importance to effect the diagnosis in their early stages between the non-malignant and the malignant varieties of this affection. In the fibrous tumor there is always mobility, and although the attachment may be deep, the skin is not involved, and the outline of the mass is usually well defined, square, and somewhat lobulated. In the scirrhous growth there is no mobility, but the mass is solidly fixed, its outline is ill-defined, the skin soon assumes a reddish-purple color, brawny, and presents the usual characters indicative of subjacent malignant action. When these tumors are medullary, they grow with considerable rapidity, feel soft, pulpy, and are ill-defined in their outline, especially under the ear and by the ramus of the jaw.

In the *treatment* of these tumors, extirpation is necessarily the only course that can be adopted; and this should not be attempted if the disease be malignant in its characters; for as it would be impossible to get away its deeper attachments, the growth to a certainty would easily return. Even if the disease be of a simple character, care must be taken that every lobule and prolongation be extirpated, for if any is left, however small, it will, without doubt, become

the nucleus of a new tumor. In removing tumors in this situation, the superficial incisions should be made free, and either longitudinal or crucial, so that the whole mass may be fairly exposed. The edge of the knife must then be directed against it, and the dissection carried on from below upwards, so that one division of the blood-vessels supplying it may be sufficient. After the tumor has been well loosened by the division of investing fasciæ and structures, and it is surprising how movable it often becomes after this has been done, though it may previously appear to have been incorporated solidly with the subjacent tissues, it should be taken hold of by the hand or a large double hook, and drawn well forwards whilst the deep dissection is being carried on. In prosecuting this, the surgeon must particularly guard against wounding the external carotid artery and the portio dura nerve, which are especially exposed to injury. In some cases the division of these structures cannot be prevented, as they are incorporated in the mass that is undergoing removal. The hemorrhage under these circumstances would of course be abundant, but may immediately be arrested by the ligature of the divided artery; indeed, in most cases the bleeding is profuse, owing to the unavoidable section of nutrient vessels and of large subcutaneous veins, but may generally be readily arrested by ligature and pressure. In other instances, however, by keeping the edge of the knife carefully against the tumor and by drawing it well forward, so as to loosen it in its cellular bed at each stroke of the scalpel, removal of the morbid mass may be effected without the division of any important vessel or nerve. After the extirpation of some small tumors of a fibrous or encysted character lodged in the substance of the parotid, there is often a great tendency to copious secondary hemorrhage, requiring pressure, or even the application of the actual cautery for its arrest. Excision of the parotid itself is occasionally spoken of, but is very rarely if ever done. I believe that in most, if not all, the cases in which it is stated that complete removal of this gland has been accomplished, tumors overlaying and compressing it, have been mistaken for it. It is evident that a diseased parotid could not be removed without the division of the external carotid and the portio dura.

Tumors of the neck. Besides tumors in the parotid region, fatty, fibrous, and encysted growths are not unfrequently met with in the submaxillary space, and in the posterior triangles of the neck. In these situations they may occasionally attain a considerable size, though they seldom extend very deeply, being superficial to the deep fascia. Hence when the integuments and superficial structures covering them are divided, the growth may be insulated with sufficient facility, its fixity being in a great measure due to its being bound down by the investing fascia rather than to its having contracted deep adhesions. Before determining upon the removal of a tumor situated in one of the triangles of the neck, it is necessary that a diagnosis be effected of its nature, and that some opinion be formed of the probable extent of its deep attachments.

The first point to ascertain is, whether it be simple or malignant. If simple, it will usually have been many years in growing; it will be hard but not stony, lobulated or somewhat square-shaped; the patient's general health being good. It will generally be found to be movable, though not perhaps to any great extent, and will present no sign of incorporation with neighboring structures; the fibres of the platysma will not appear to spread over it, and the sterno-mastoid may be traced to one side of or below it. Under such circumstances the removal of the tumor may be undertaken by any surgeon possessing a fair share of anatomical knowledge and manual skill, with every prospect of success. But if the tumor be of stony hardness, have implicated the skin, be immovable, the whole head moved on any attempt at drawing it aside; if it be defined under the jaw and ear, or rapidly growing, soft and pulpy to the feel, deeply seated under the angle of the jaw, evidently below the platysma and deep fascia of the neck, and possibly beneath the sterno-mastoid, then no attempt at

extirpation should be undertaken, as the mass could either not be removed with safety, or if it were by any possibility extirpated, then necessary contamination of the neighboring parts would certainly lead to a speedy recurrence of the disease

A peculiar cystic tumor, the *hydrocele of the neck*, has been described by Maunoir and Phillips. The disease usually appears in the posterior inferior triangle, forms a largish bladder-like tumor, unilocular in some cases, multilocular in others; filled with a yellow or chocolate-colored sero-albuminous fluid, and may attain so large a size as to interfere with deglutition and respiration; the skin covering these growths is not discolored, but thin and expanded. The treatment consists in the introduction of a seton after the tumor has been tapped.

Enlargement of the lymphatic glands of the neck either terminating in chronic induration or abscess, is of such common occurrence as to constitute perhaps the most frequent form of glandular enlargement. The tumors thus formed, present nothing peculiar in their progress or treatment when occurring in this situation, except that when abscess forms it should be opened early by a small incision, and in such a direction, corresponding to the natural folds of the skin, as to leave as little scarring as possible.

BRONCHOCELE.

The thyroid gland is subject to various chronic enlargements which commonly go by the name of *bronchocele*. It may be simply hypertrophied, and may then attain a very considerable size; in some cases forming an immense lobulated tumor on the forepart of the neck, such as is met with in various districts of this country and of the continent, in which the disease is endemic. In the majority of instances these tumors are, however, of but very moderate size, commencing at first as a mere fulness and uniform or rounded enlargement of the isthmus, or of one of the lateral lobes of the thyroid gland, and gradually increasing, until perhaps by the pressure of the growth confined between the sterno-mastoid muscle and the deep structures of the neck, respiration and deglutition become seriously affected. There is a remarkable connection between tumors of the thyroid gland of this kind, and a general anemic condition of the system. In London nothing is more common than to find a certain degree of bronchocele in pale and bloodless women and girls; indeed so frequent is the coincidence that it is impossible not to regard it in the light of cause and effect. Mr. W. Cooper has pointed out the fact, that great prominence of the eyeballs is frequently associated with these conditions.

In some cases *cystic tumors* are met with in this gland, either associated with general hypertrophy of it, or occurring independently of this. These cysts, which may be single or numerous, usually contain a dark bloody-looking fluid, and have often cauliflower-like excrescences projecting into their interior. In some instances pulsation has been observed in a bronchocele. This may either be communicated by the artery lying beneath it, or be owing to the very vascular character of the tumor itself. In either case, when confined to one lobe only, care must be taken not to confound the beatings with carotid aneurism, a mistake that I have known to occur, and the diagnosis of which has been adverted to at page 539.

The *treatment* of bronchocele must vary according to the size and character of the tumor; when small, and associated with anemia, and of comparatively recent formation, it is best treated by improving the general condition of the patient by the administration of iron internally, especially the iodide, with the external application of the iodine or iodide of lead ointment. When of large size, its absorption cannot, I think, be expected to take place by these or any other means, and the question then arises as to the propriety of having recourse to operative interference. The excision of the tumor is seldom to be thought of;

its vascularity is so great, and the arterial supply that it receives from both sets of thyroid arteries so abundant, that any attempt at extirpation must generally be attended by such profuse hemorrhage as necessarily to prevent the completion of the operation. Cases have, it is true, occurred to Roux and others, in which large bronchoceles have been successfully extirpated; but these operations must be looked upon as altogether the exception in the treatment of the disease; and cases are certainly not often met with in which a surgeon would think it proper to undertake so serious a procedure for an affection that is not necessarily mortal. In the event of its being thought desirable to operate, the better plan would be, after exposing the tumor, to enucleate it as much as possible with the handle of the scalpel, ligaturing carefully all the vessels divided as they were cut.

The ligature of the thyroid arteries has been practised by some surgeons, and it is stated, with a certain degree of success. The difficulties and danger of the operation, the uncertainty of its results, and the readiness with which the arterial supply would be forwarded to the tumor from other sources, have caused it to be but little resorted to by surgeons of the present day. The introduction of a seton across the tumor is occasionally attended by beneficial results. This operation, however, is not unaccompanied by danger; a patient on whom it was being performed in the neighborhood of London a few years ago, having lost his life by the puncture of a vein at the root of the neck, into which air was spontaneously admitted.

In some instances the employment of pressure has been of use, especially in conjunction with the iodine inunctions; though it is not easy to apply this means, and any considerable degree of it can necessarily not be borne, on account of the increased difficulty of respiration that is thus occasioned. In fact, the compression exercised upon the tumor by the sterno-mastoid muscle in some of these cases is occasionally so considerable, that it becomes necessary to divide its tendon subcutaneously, in order to relieve the trachea from the constriction to which it is thus subjected. When the tumor is chiefly of a cystic character, the fluid contents may be drawn off by tapping, and an endeavor may be made to get the cysts to close by inducing inflammation in them by the injection of tincture of iodine.

CHAPTER LII.

DISEASES OF THE BREAST.

These affections when occurring in the female, are of great interest to the surgeon, not only on account of their great variety, but from the difficulty of diagnosis attending them and the importance of determining the question of operative interference in connection with them.

The mammary gland is subject to certain anomalies as to development; thus, in some instances, it has been found to be altogether wanting. Sir A. Cooper and Froriep both relate instances in which this structure was not developed, and in which the ovaries were also deficient. A more remarkable anomaly consists in the development of a number of supernumerary breasts. Birkett has collected 14 reported cases, in which there were more than two breasts; more frequently there is but one supernumerary gland, sometimes two, and occasionally, though very rarely, three have been met with, constituting quintuple

mammæ. Supernumerary nipples have likewise been found to occur; two to each breast have been met with, each communicating with the gland, and passing milk. Most frequently the supernumerary breast is situated somewhere in the neighborhood of the normal gland, as on the anterior part of the thorax; and where four are developed they have been found placed in two parallel rows one above the other. Occasionally they have been met with in very strange situations; thus they have been seen on the outer part of the thigh, in the groin and on the back; and children have even been known to have been suckled by these abnormal breasts.

Diseases of the breast seldom occur before puberty, being most frequently met with either during lactation, when the functions of the gland are in a high degree of development, or towards the termination of menstrual life, when the actions of the organ are necessarily influenced by the changes that are taking place in the uterine system. Before puberty, the breast occasionally, but rarely, becomes the seat of inflammation and abscess, in all probability accidentally so, these changes taking place in it in the same way that they might in any other part of the body. More serious disease has, however, been met with in the mammary gland, even at this very early age; thus, Mr. Lyford has recorded a case of cancer of the breast in a girl of eight. As the period of puberty approaches, the breasts often swell, become hard, knotty, and somewhat painful, indicative of some commencing change in the generative system. In other cases again a precocious hypertrophy may take place, frequently attended with severe neuralgia in the part. When puberty occurs the breasts naturally enlarge, and often become tender, and occasionally one undergoes a certain degree of hypertrophy, increasing greatly in bulk beyond the other. These various changes, though exciting alarm in females, cannot be regarded as of any serious importance, and seldom require more than the simplest surgical treatment.

Neuralgia of the breast occasionally occurs to so severe a degree as to constitute a positive disease, either in girls or at a more advanced period of life, when it not unfrequently complicates other more serious affections of this organ. It is especially apt to occur in young, delicate, unmarried females of the hysterical temperament, though it is often met with in strong, ruddy-looking women, who are perhaps subject to neuralgic pains in the back, and in other situations. Most commonly the catamenia will be found to be irregular, and uterine congestion, inflammation, or ulceration, will be discovered on examination; indeed, of late, since the attention of the profession has been drawn to these affections, I have scarcely ever failed to detect one or other of these conditions in the uterus in cases of irritable breast.

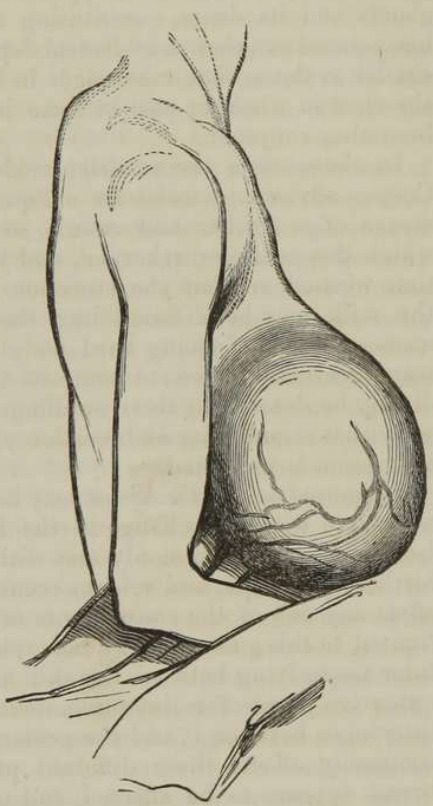
In neuralgia of the breast the mammary gland may be of its normal size and consistence, but in some instances the whole of it is more or less indurated and hypertrophied. There is always much general pain and aching deeply in its substance, with cutaneous tenderness of its surface, and lancinating or radiating sensations that extend into the axilla and down the arm. These painful sensations are commonly increased before the menstrual period, and not unfrequently alternate in opposite breasts. The diagnosis of this affection from the more serious mammary disease may usually be effected by attending to the superficial and radiating character of the pain, to the temperament of the woman in whom it occurs, its shifting seat, and the absence of any positive signs of disease in the breast.

The *treatment* consists especially in attention to the condition of the uterine organs; unless this be done in a proper way, the disease will prove to be excessively rebellious and troublesome to manage. By using the speculum, however, when necessary, and removing any uterine irritation that may be found by proper remedies, this affection will yield with far greater readiness than by any other plan of treatment. At the same time, anti-hysterical constitutional

remedies may be employed; the preparations of iron administered, when necessary; and the local pain relieved by the application of belladonna and opiate plasters, or inunctions with atrophine ointment.

Simple hypertrophy of the breast not unfrequently occurs, associated with very severe neuralgia of the organ. An increase of size, such as naturally takes place during pregnancy, between the fourth and the ninth months, will occasionally commence at puberty, and go on until the organ attains an enormous bulk, as in fig. 303, which represents the breast of a girl of fifteen. In some cases the breast has been found to weigh as much as twenty pounds after death; and after removal, a breast of this kind, taken from a young woman under thirty, has weighed no less than twelve pounds, being entirely composed of its normal tissues, greatly hypertrophied. In these cases of hypertrophy, both breasts are usually affected, though one is commonly more so than the other. When first this morbid condition commences, the breast preserves its usual shape, though it is increased in bulk; but as it enlarges it gradually projects forwards, drawing down the skin of the shoulders, of the sides of the chest, and even of the back, and hanging downwards, until, as in a case mentioned by Berard, it has been known to reach to the knees. The treatment of this affection is very unsatisfactory. The general health must be attended to, and an endeavor may be made to excite lactation, and thus to unload the vessels of the breast by the employment of galactogogue remedies. I do not think that amputation of the organ should be performed in these cases, unless the growth attain so great a size as to render life a burden. The *lobular hypertrophy* of the breast, described by Sir A. Cooper, as occurring chiefly in unmarried women between thirty and forty years of age, and which appears on manipulation to be composed of several solid but movable masses, that after a time begin to diminish in size, until the breast at last atrophies, and is in a great measure absorbed, seems to me to be rather a species of the chronic mammary tumor than of pure hypertrophy.

Fig. 303.



The *lacteal secretion* is occasionally the cause of abnormal conditions in the breast; thus the milk may appear at unusual times, a twelvemonth, for instance, after weaning; it has occasionally been known to be secreted in children, and in some remarkable instances in men. In other instances, again, after parturition, there is a total absence of milk, either owing to want of development in the gland, or to debility on the part of the mother. The opposite condition will occasionally occur, and an excessive flow of milk may continue in hysterical females after the child has been weaned. In such cases as these, the *galactorrhœa* may be checked by the employment of tonics, the administration of acids, &c.

It may happen during lactation that one of the lactiferous ducts becomes obstructed, either by its becoming obliterated by inflammation or occluded by

the deposit in it of a small concretion — a lacteal calculus. In either case the walls of the duct may be expanded, so that at last it constitutes a moderate-sized cyst, fluctuating on pressure, and evidently containing fluid. In some cases the lacteal tumor has been known to attain an enormous size. A M. Walpy has related a case in which he drew off ten pounds of milk by tapping a collection of this kind. These tumors may exist for a considerable time. Dupuytren records an instance in which it had existed for ten months, and Cooper one of a year's duration. In these chronic cases the milk usually undergoes changes; becoming creamy, thick, and oily, and in some instances would appear by the absorption of its watery parts to leave a solid residue. In other instances, again, the milk appears as if diffused through the substance of the glands and its ducts, constituting a spongy semi-fluctuating tumor. Velpeau has pointed out that these lacteal deposits undergo a series of changes, somewhat similar to those that take place in blood that has been extravasated, becoming absorbed in whole or part in some instances, in others left fluid, and in others becoming encysted.

In these cases the readiest mode of getting rid of the tumor is, as Sir A. Cooper advises, to make an oblique puncture from the nipple towards it, by means of a trochar and canula, so that a fistulous track may be left, along which the milk is discharged, and thus got rid of, the child being at the same time weaned, so that the secretion may cease. In some cases after weaning, the milk may be diffused into the substance of the gland or collected into masses of curd, forming hard nodules, which give a good deal of trouble, and may eventually go on to some of the forms of inflammation that will immediately be described; these swellings are usually best got rid of by frictions with somewhat stimulating embrocations, such as camphorated oil, &c., by which their absorption is promoted.

Inflammation of the breast may take place at any period of life, but is usually associated with that change in the function of the gland which occurs during lactation. It is commonly met with during the first month or two after the birth of the child, and seldom occurs during weaning. The inflammation may affect any one of the constituents of which the breast is composed, and may be limited to this; thus it may take place in the nipple—in the subcutaneous cellular tissue lying between the skin and the gland—in the gland itself, or in that extensive plane of cellular membrane upon which the gland rests, and which intervenes between it and the pectoral muscle. But although the inflammation commonly affects these different parts, yet in many cases the whole of the breast appears to be affected, and no distinct implication of any special tissue can be made out.

Inflammation of the nipple and areola usually occurs at an early period of lactation in delicate women, and especially during their first pregnancy. It commences in the follicles of the part, accompanied by superficial ulceration, abrasion, fissure, and cracks, with oozing of a small quantity of thin, sero-puriform fluid, great pain during suckling, so much so indeed as to prevent the proper continuance of this act; and is usually accompanied by a great deal of constitutional irritation. In some instances the fissured state of the nipple would appear to precede the setting in of inflammation; in other cases again, the inflammation is the primary condition. When the areola and nipple are inflamed, these parts become conical, red, and swollen, with much pain, owing to the density of the subcutaneous tissue in this situation. When this disease, commonly called *cracked nipple*, has set in, most relief is afforded by the application of the nitrate of silver to the bottom of the fissures, and over the inflamed surface. This application, though painful at the time, gives the patient afterwards more complete ease than any other with which I am acquainted. In some instances the application of the citrine ointment, and in other and slighter cases that of collodion is useful. When inflammation exists, with superficial

abrasion, but without any distinct crack, the employment of astringent applications, such as the tincture of myrrh and of catechu, borax and honey, or spirit and water, may be useful. In these cases also, a leaden nipple shield may be employed with advantage, and the state of the infant's secretions should be carefully attended to; the occurrence of aphthous ulcers in the mouth being followed with especial frequency by the disease in question.

Abscess of the areola not unfrequently occurs in suckling women, with the ordinary signs of local inflammation, terminating in circumscribed suppuration. The treatment consists in the application of warm poultices made with lead lotion, and lancing the part early. In doing this, care should be taken that the cut be made from the centre of the nipple towards the circumference of the areola, so as not to cut the lacteal ducts.

The inflammation of the breast, which, as it generally terminates in suppuration, is usually called *milk abscess*, may occur in three situations; 1st, in the subcutaneous cellular tissue; 2d, in the bed of cellular tissue in which the mammary gland is lodged; and 3d, in the gland itself.

1st. Inflammation, followed by abscess of the subcutaneous cellular tissue of the breast, though commonly occurring during lactation, is more frequently met with than any other form of inflammation in this region at other periods of life, more particularly about the age of puberty. Its symptoms are those of simple phlegmonous inflammation of these structures, differing in no way from abscesses of this kind in other situations, except that it is always distinctly circumscribed.

2d. When inflammation occurs in the cellular plane which lies between the mamma and the pectoral muscle, it diffuses itself over the whole of the cellular layer, and almost invariably runs into abscess with considerable rapidity, giving rise to great pain in this situation of a deep, heavy, and throbbing character, much increased by moving the arm and shoulder, attended by swelling, œdema, and a slight red blush upon the skin. The breast becomes prominent, is conical and projecting, the whole organ being pushed forwards by the pressure from behind; the subcutaneous veins become engorged, and at last abscess forms. It is not always easy in these cases to determine whether suppuration has taken place or not, the depth at which matter forms rendering it impossible in the early stages to detect fluctuation until it approaches the surface; its presence may, however, be suspected by the occurrence of deep-seated throbbing pain, œdema, and some superficial redness. The abscess at last points at some part of the margin of the gland, usually at its lower and outer side, where the matter seems to gravitate; after a time, however, it will commonly appear at other points of the circumference of the gland, beyond which it always extends, though it seldom, if ever, perforates the structure. I have, in more than one instance, seen a series of four or five apertures, forming a large circle round the margin of the gland. It very commonly happens that the aperture through which the pus discharges itself in these situations, degenerates into fistulous canals, by no means easily closed.

3d. Inflammation of the gland itself is not of such frequent occurrence as either of the other forms of abscess; when the whole of the organ is affected, it gives rise to great swelling of the breast, with severe aching and lancinating pain, and much constitutional disturbance, usually of an irritative type. Not unfrequently one lobule only of the gland becomes inflamed, and then the local signs are proportionately limited, and occasionally cease. As Velpeau has pointed out, one lobule after another may become inflamed, so that a succession of abscesses forms in different parts of the gland. As the inflammation advances to suppuration, the skin is reddened, assumes a dusky hue, becomes glazed, has a peculiar greasy appearance, and pits on pressure. When matter has formed, the tension of the superficial parts with œdema and perhaps deep-seated fluctuation determine its presence.

In the *treatment* of inflammation and abscess of the breast occurring during lactation, it must be borne in mind that we have not a sthenic inflammatory condition to deal with, but that the disease almost invariably happens in pale delicate women, commonly of a strumous habit, and weakened by recent parturition; indeed the affection appears to be rather an inflammation of an irritative and congestive, than of a sthenic character. It is therefore obvious that antiphlogistic means of an active nature are not admissible; and the best plan of treatment appears to consist in keeping up the strength of the patient by proper constitutional support, at the same time that the local inflammation is checked by topical antiphlogistic measures. The first thing to be done is to prevent the occurrence of suppuration; if this can be accomplished, which is, however, rarely the case, much will be gained. In order to effect this, the breast should be supported in a sling, so as to lessen congestion in it, and the arm at the same time should be fixed to one side in order to prevent traction of the pectorals and movement of the submammary cellular tissue. If the patient's strength is good, leeches may be applied; in the majority of cases, however, they will not be required, but warm evaporating lead lotions or the assiduous application of chamomile or poppy fomentations may be substituted in their stead; at the same time the milk should be drawn off by means of a breast-pump or sucker, the child being put to the unaffected breast or weaned, and an occasional saline purgative administered. When suppuration is impending, the application of fomentations may be continued, the patient being allowed a more liberal supply of nourishment, with a moderate quantity of malt liquor; and so soon as matter can be felt, it should be cut down upon and let out by an aperture in the most dependent position. It is of great importance that the matter should be let out early, and by an opening into the lowest part of the abscess; if it is not, it burrows deeply, diffusing itself through the cellular tissue under, beyond, and around the gland, and opening at several points, leaves long fistulous tracks perforating the breast in various directions. When suppuration is going on, the patient's strength must be supported with tonics, the mineral acids, bark and quinine. Porter must be liberally allowed, and plenty of nourishment given. The sinuses that are left may usually be got to close by attention to the state of the general health: should they not do so, however, the employment of pressure and the use of stimulating injections may, in time, accomplish this. In the event of their proving rebellious, it has been proposed to slit them up, but this is an unnecessarily severe practice, and may, I believe, in all cases be dispensed with.

Chronic or *encysted* abscess of the breast, is a disease of great importance, inasmuch as it simulates closely various tumors in this situation; so much so, indeed, that it is only with extreme difficulty that the diagnosis is effected in some cases. It may commence either as the result of acute lacteal inflammation, but more commonly without any distinct cause; as the consequence, probably, of a very chronic and gradual engorgement of the cellular tissue in this region. An indurated indolent swelling forms, and this may gradually soften in the centre, but fluctuation may for a long time be very indistinct, and even absent, being obscured by the thick wall of plastic matter that is thrown out around the collection of pus. It is owing to the deposition of this dense mass of limiting fibrine that the encysted abscess is commonly developed as a hard and apparently solid lump. It is in general not very distinctly circumscribed, and of but moderate magnitude, after a time remains stationary, or but slowly increases with but little pain during a space of many months; and is not unfrequently attended with retraction of the nipple.

The diagnosis of this form of abscess is of great importance, inasmuch as it has not unfrequently been excised for tumor of the breast. I am acquainted with many instances in which this mistake has been committed. Such an error may, however, commonly be avoided by observing that the abscess commences

during lactation; that although it is of slow formation and without pain it is not distinctly circumscribed, but gradually fuses in an irregular manner into the neighboring tissues; that it is not freely movable, but rather incorporated with adjacent parts; and that elasticity, or even fluctuation may be commonly felt at one part of it. Should there be much doubt in the case, the introduction of a grooved needle by giving issue to the pus, will always determine its true nature; indeed this simple means of diagnosis should never be neglected in all cases in which there is reason to suspect the possibility of the apparent tumor of the breast being in reality an abscess. The cure of these encysted abscesses of the breast may most conveniently be effected by making a puncture into them, and then passing a seton across them in a perpendicular direction; the inflammation thus excited in the tumor will speedily lead to its being softened down, and eventually disappearing.

TUMORS OF THE BREAST.

The study of the various tumors of the breast, more especially in a diagnostic point of view, is of the first importance to the practical surgeon; for though it might be supposed that it would be easy, if not to recognize the minuter shades of pathological difference between morbid growths so superficially situated as those of the mammary gland; at all events to diagnose the malignant from the non-malignant affections of this organ; yet in practice nothing is more difficult in many cases; and it not only requires great experience, but also an intimate acquaintance with the special course and symptoms of each particular disease, to come to a correct conclusion as to its nature. Even with all the light that experience and a careful examination of the characters of the tumor may throw upon the nature of the disease, it will be impossible for the surgeon to avoid occasional errors in their diagnosis.

NON-MALIGNANT TUMORS.

Mammary tumors may be of a simple or a malignant character. The recognition of the different varieties of simple tumor that affect the breast gland, is principally due to Sir A. Cooper; and this department of surgical pathology has of late years been much extended by the researches of M. Velpeau and Mr. Birkett. The non-malignant tumors of the breast comprise the *chronic mammary tumor*, the different varieties of *cystic growth*, the *painful tubercle*, *hydatid cysts*, and various forms of *fibrous*, *cartilaginous*, and *osseous* growths.

The *chronic mammary* or *adenoid tumor* is perhaps the most common variety of these benign structures. It usually occurs as the result of blows, squeezes, or lacteal irritation, and is almost invariably met with in young women under thirty years of age; seldom if ever occurring at a later period than forty; usually in persons otherwise hearty; and most frequently in those of a sanguineous nervous temperament. This tumor is generally of small size, though occasionally it may attain the bulk of the fist. On examination after removal, it appears irregularly lobulated, and its cut surface will be found to present a bluish or greyish-white color, which after exposure to the air assumes a rosy tint, and on pressure, drops of a thick creamy fluid will often be seen to exude. Under the microscope it has been found, by Mr. Birkett, to consist of imperfectly developed hypertrophy of the glandular tissue; the terminal cells of which are filled with epithelial scales.

This tumor usually commences as a small, movable, finely nodulated growth, attached by a pedicle to one side of the mammary gland; it is hard and incompressible, often appears isolated, and not generally painful; it increases slowly, and without discoloring the skin or becoming attached to it, and is often many years in attaining a moderate size. It is often floating as it were in the sub-

stance of the gland, into which it can be pushed back. These tumors are frequently mistaken for cancerous growths, and the diagnosis is often as difficult as it is important; though, in many cases, the otherwise good health of the patient, the mobility of the mass, the absence of all implication of the skin or glands, the want of hardness and of a circumscribed character will usually indicate its true nature.

The *treatment* consists in attention to the general health, and the employment of local absorbent remedies. In this way tumors of this description have occasionally disappeared; in some instances they have been known to become spontaneously absorbed after marriage or during pregnancy. If obstinate, their dispersion may be facilitated by the occasional application of two or three leeches, followed by inunction of the iodide of lead ointment; and the internal administration of Plummer's pill, and the compound decoction of aloes. In addition to these means, the employment of compression will be found especially serviceable; this may be applied either by means of Arnott's slack air-cushion, or by using a pad to which a spiral spring is attached, and which being compressed by a proper arrangement of bandages across the chest will keep up steady and continued pressure upon the tumor. I have employed this kind of apparatus, which is far less expensive and cumbersome than the air-compressor, in several cases of mammary tumor with great advantage. The advantage attending it is that it can be used in conjunction with absorbent ointments, which cannot be used with the air-bag, as the grease entering into their composition destroys the macintosh cloth of which it is made. In this way absorption may not unfrequently be secured; and I am disposed to think that not a few of the so-called cases of cancer of the breast that have been reported as having been cured by pressure, were, in reality, instances of the chronic mammary tumor in which absorption had been brought about in this way. Should the growth attain too great a magnitude to admit of absorption by the means that have just been recommended, its excision must be practised. In doing this it is not necessary to remove the whole of the breast, but it will be quite sufficient to extirpate the tumor itself. If the growths implicate the edge of the mammary gland, this may be done by two incisions that radiate from the nipple as from a centre, thus inclosing a triangular portion of the breast. If it be movable and be in the substance of the gland itself, it may often be enucleated through a simple incision.

It occasionally happens that the chronic mammary tumor becomes the seat of intense neuralgic pains of a very severe and paroxysmal character, attended with very considerable cutaneous sensibility, constituting the form of disease that goes by the name of the *painful mammary tumor*. This condition most frequently occurs in early life, and in women of an irritable and delicate constitution; it is commonly associated with disorder of the uterine functions, the pain increasing at the catamenial periods, and appearing to be essentially owing to the implication of some of the twigs of the intercosto-humeral nerves in the disease. The treatment of this affection must have special reference to the removal of the neuralgic condition. This is commonly best effected by the internal administration of alteratives and tonics, more particularly of the preparations of iron and zinc, with cod-liver oil if necessary, and by the inunction of the iodide of lead ointment, conjoined with belladonna or aconite into the affected breast. In many cases the application of a few leeches, from time to time, more particularly in the vicinity of the axilla, will lessen the neuralgia more effectually than any other plan of treatment; and, in others, again, pressure will be found serviceable. If all other means fail, excision of the tumor may in this, as in the last case, ultimately be found necessary.

Cystic tumors of the breast are amongst the most common of the non-malignant affections of this organ. They may occur in three distinct forms: 1st. As a single unilocular cyst; 2d. As several of these cysts occurring together; and

3d. As the cysto-sarcomatous tumor, in which the cystic development appears to be superadded to a structure analogous to that of the chronic mammary tumor. Besides these forms of non-malignant cystic tumor, we occasionally meet with cystic cancer of the breast.

The single or unilocular cyst of the female breast, described by Sir B Brodie as the *sero-cystic tumor*, and by Sir A. Cooper as a variety of hyatid tumor, usually occurs in the form of a small thin sac, about the size of a filbert, containing a clear serous fluid, imbedded in the granular substance of the breast, and movable under the skin; most commonly more than one cyst of this kind is present in the breast, though as one attains a greater development than the others, the smaller ones may readily escape detection. These cysts, when single and small, always contain a clear serous fluid, but as they increase in size, or become multiple, their contents may assume a greenish, brown, or blackish tinge. They may continue for a great length of time of small size, but in other cases, again, they gradually increase until they contain several ounces of serum. Sir B. Brodie is of opinion that they are originally formed by a dilatation of the lactiferous tubes, and refers to a preparation in which this position can be demonstrated. The diagnosis of the affection may usually be readily effected by feeling the globular elastic cyst or cysts under the skin; the mammary gland being movable, and not adherent to any of the adjacent structures. In those cases, however, in which the tumor lies deeply, the diagnosis may not so readily be made, more especially from some of the cystic forms of cancer to which I shall by and by have occasion to advert. Whenever the surgeon has any doubt about the existence of fluid in a tumor of the breast, he should introduce an exploring trochar, when, if the disease be cystic, the fluid will be discharged. If the tumor prove to be solid, no ill consequences will result from the simple puncture. Two instances have lately occurred to me, in which, from want of this simple precaution, very excellent surgeons had condemned as cancerous, tumors of the breast that proved to be cystic.

Unilocular cysts of the breast occasionally attain an immense size, at the same time that their walls continue thin and supple. In some of these instances, the fluid continues to the last of a truly serous character; in other cases, however, it becomes more or less glairy or mucilaginous, and hence Velpeau has described this variety as the *sero-mucous cyst.* In other cases, the walls of the cysts have been known to undergo calcareous degeneration. When these cysts attain a very large size, their walls being thin, and the skin covering them tense, they may become translucent, and thus constitute a true hydrocele of the breast, resembling in many respects similar serous tumors that form in the neck.

In the majority of instances, as has already been observed, no material change takes place in the cyst, except, perhaps, its gradual increase in size; but in other instances, peculiar changes occur in them, in consequence of which they become filled up by a dense solid growth springing from their interior, at last undergoing ulceration, and giving rise to a series of destructive changes. The pathological phenomena that accompany these changes have been ably investigated by Sir B. Brodie. He finds that, in the first instance, one or more membranous cysts, containing serum, are formed in the breast; the fluid gradually becomes darker in color, and opaque; after a time, a fibrinous excrescence, of a lobulated or foliated form, springs up into the interior of the cyst, gradually displacing and occasioning absorption of the contained fluid, and, at last, filling up the whole of its interior; and then coming in contact with the capsule by which it is compressed, or with which it may be firmly incorporated, the whole tumor is converted into a solid mass, in which the remains of the cysts still continue to be perceptible. Sir B. Brodie thinks there is reason for believing that a growth of a fibrinous substance takes place from the outer side of the cyst as well, thus adding to the general size of the breast. If one of the larger cysts be laid open, or if the pressure of the intra-cystic growth cause inflammation and ulceration

of its capsule, this may at last be perforated, and a fungous mass will sprout through it, presenting many of the ordinary symptoms of a malignant growth, being irregular, dark-colored, bleeding readily, and increasing rapidly in size. When such changes as these have taken place, the tumor assumes a formidable character, and will rapidly prove fatal by the induction of exhaustion and hectic. Tumors of this description, composed of cysts having intra-cystic growths sprouting from their interior, may attain an immense magnitude and weight. They have been met with of six, eight, or even twelve pounds weight, but the largest is one described by Velpeau, which weighed forty pounds.

The various forms of cystic tumor that have just been described, when associated with the development of fibrinous intra-cystic matter, constitute forms of the so-called *cystic sarcoma*. Another variety of this disease, however, is not unfrequently met with, in which the sarcomatous or solid element of the tumor preponderates over the cystic part of the growth. In these cases the tumor will be found to be composed of a dense, white, lobulated, or foliated structure, closely resembling that of the chronic mammary tumor, and consisting either of imperfect hypertrophy of the breast-gland, or of the deposit of a fibrinous material. This mass is studded throughout with a number of small cysts, varying in size from a pin's head to a hazel-nut, and usually containing clear fluid. If some of these cysts increase out of proportion to the rest, the tumor will assume more of the true cystic character.

This form of cystic sarcoma usually occurs in women from thirty to thirty-five years of age, as the result of injury or as the remote consequence of some inflammatory action during lactation. On examining a breast affected in this way, it will be found that the tumor, which may either be confined to one lobe, or implicate the whole of the gland, is hard, heavy, and solid to the feel; on careful examination, however, its surface may be felt to be finely nodulated; and, occasionally, a larger cyst than usual may be found projecting, which is recognized by its elastic feel and globular shape. The disease is slow in its growth, and does not implicate the adjacent cutaneous or cellular structures; hence, the tumor is movable on the pectoral muscles, and the skin is unattached to it. The axillary glands, also, are not enlarged, at least not to any material extent. The nipple will always be found to be normal in its shape, and not depressed.

The *treatment* of these various forms of cystic and sarcomatous growths varies, according to the size of the cysts, and the quantity of solid matter deposited inside and around them. When the cysts are small, the fluid contents may be let out by puncturing with a small trochar; but a cure cannot usually be effected in this way, as the fluid readily re-accumulates. In such cases as these, Sir B. Brodie has found considerable advantage in the application of stimulating embrocations, more particularly of one composed of equal parts of camphorated spirit and weak spirit, with one-eighth part of liquor plumbi. In other cases, blistering and the application of the tincture of iodine, may be serviceable. Under these plans of treatment I have several times seen the tumor disappear, occasionally it will suppurate and is thus got rid of. Should, however, these plans of treatment produce no good effect, it may be necessary to remove the whole of the breast affected by the disease. It is better either to leave the tumor and treat it by palliatives, or to remove the whole breast; partial removal of the breast, extirpation of the tumor, with its lobe of the mammary gland, is not usually a very successful operation. Often very severe inflammation of the glands and of the succeeding textures is set up. This I have seen on several occasions, and therefore think it better that the breast should either be left, or removed in toto. Such an operation, however, should not be undertaken in the early stages, as the tumor may continue for many years without seriously troubling or endangering the patient, and may perhaps eventually undergo atrophy or absorption. If, however, it show a disposition to increase, to become troublesome by its bulk, or painful, it should then certainly be extirpated, and

this operation may always be performed with a good prospect of success, inasmuch as the disease is not malignant, and does not tend to contaminate the constitution. It is a remarkable fact, however, which has been adverted to by Lawrence and Brodie, that even though the whole of the breast be extirpated, a similar affection occasionally recurs in the cicatrix, requiring subsequent operation; and then, perhaps, being permanently eradicated. This must either be owing to some portion of the cystic structure having been left in the first operation, or to the development of new cysts in the site of the former; but to which cause it is referable is still uncertain. A still more remarkable circumstance connected with these tumors is, that after their removal a recurrence of cancer will occasionally take place in the cicatrix. The repeated recurrence of these cystic tumors is very remarkable. Mr. Cæsar Hawkins relates a case in which the growths had to be removed eight times for as many recurrences.

Besides these tumors, the breast is occasionally the seat of other morbid growths; as for instance, fibrous, osseous, and cartilaginous masses have been met with in this situation. All these affections, however, are of extremely rare occurrence, and when they form it is almost impossible to determine their true nature until after removal. Their extirpation is usually practised on account of the obscurity attending the diagnosis, and the fact of their commonly being mistaken for cancerous growths.

Sir A. Cooper describes a *scrofulous tumor* of the breast, the precise nature of which is not very apparent from the account given by that surgeon. It is not improbable, however, that it is of a tuberculous character; and Velpeau states that he has found tubercles occurring in the breast in two forms. In the first, principally deposited in the skin and subcutaneous cellular tissue; and in the other, of a fibro-tuberculous character, affecting the gland itself.

Hydatids of the breast are of rare occurrence, and have been principally described by Sir A. Cooper, and cases have been related by Graefe and others. These hydatid tumors are so excessively rare and obscure that their true nature would not in all probability be suspected until after removal. They present the ordinary characters of a deeply-seated cyst, with fluctuation and some induration round the globular swelling, and an absence of pain. In such a case as this, an incision into the tumor will cause the escape of the acephalocysts, and the ultimate suppuration of the cavity in which they lodged, which will gradually cicatrize. In some rare cases, tumors containing fœtal remains have been met with in the breast; these cases, however, are rather matters of surgical curiosity than of practical importance.

MALIGNANT TUMORS OF THE BREAST.

All the various forms of cancer have been met with in the breast; scirrhus, however, occurs with far greater frequency than any of the other varieties. Occasionally the encephaloid form of the disease is met with, but colloid very rarely occurs; indeed, the only case of colloid of the mammary gland, with which I am acquainted, is that in a preparation in the University College Museum. Cancer of the breast, whatever form it assume, is invariably primary: it may affect one lobe only, or be infiltrated into the whole gland; and it may commence in the nipple or in the skin covering the breast. Most frequently only one side is affected, but in some cases both mammary glands are implicated.

Scirrhus is that form of cancer that is commonly met with in the breast; it may occur in several ways, either as affecting the nipple, as being deposited in the form of an intra-mammary tumor, or as infiltrating the whole substance of the organ. It most commonly commences as a circumscribed tumor of small size, at first perhaps smooth and round, hard and indolent in its character, with little or no pain; it is readily movable, may be situated in one lobe, and at-

tached perhaps to the rest of the gland by a distinct pedicle. As it increases in size, it becomes hard, knobbed, and irregular, perhaps presenting a finely granular feel, and becoming fixed to the gland and subjacent parts. When the disease begins as scirrhous infiltration of the breast, the gland is from the first, hard, rugged, irregular, nodulated, and heavy; often somewhat square in shape, and early accompanied by adhesions to subjacent parts. In other cases again, the development of the scirrhous mass is accompanied by a corresponding atrophy of the mammary gland, which becomes shrivelled and disappears entirely. In some instances rather large cysts may form in connection with these scirrhous masses. In a woman, whose breast I lately removed, for what was supposed to be cystic sarcoma, but proved after the operation to be a scirrhous tumor, the mass contained several cysts as large as cherries, filled with dark or greenish fluid, and projecting from its surface; and in a lady who is at present under my care for scirrhus of the breast, a tumor as large as a pigeon's egg, containing sanguinolent fluid, formed on the surface of the tumor.

As the swelling increases in size, it has a tendency to become more fixed to the subjacent parts, becoming adherent to the pectoral muscles, and incorporated with the cellular tissue at the border of the axilla. The tumor also begins to form a distinct external projection, becomes more irregular in shape, is the seat of severe pain, more particularly at night, and is usually covered by a plexus of blue and dilated veins. The ordinary symptoms of cancerous cachexy now begin to set in, and the disease then makes still more rapid progress.

The tumor may in some cases remain for a great length of time without implicating the skin, but most commonly after it has existed for a few months this tissue becomes more or less involved in the morbid action. Instead of being loose and movable over the surface of the tumor, it will be found, on being pinched up between the fingers, to dimple at one part, where it may be felt to be attached by a kind of cord-like process to the tumor beneath it. After a time, that portion of the skin which first became fixed in this way, acquires a reddish or purplish color, and is covered with thin, scaly, epidermic desquamations, and becomes permeated by a number of small ramifying vessels. A crack or fissure eventually forms in this; a small exudation of a mucous fluid takes place, which dries into a scab; under this, ulcerative action sets in, which speedily assumes the ordinary characters of a scirrhous ulcer, having hard, elevated, and everted edges, a greyish-green or foul surface, and discharging a quantity of very fetid pus. In some cases ulceration may take place at several points, and thus the whole surface of the breast become converted into one immense chasm, which may even extend up into the axilla.

The skin, when affected, often assumes a red, glazed, hard, and brawny character, being shining, and as if greasy upon the surface, having its pores enlarged, and enveloping the side of the chest in a kind of stiff, solid casing, attended usually by much pain, considerable œdema of the arm, and an aggravated form of constitutional cachexy; ulceration at last takes place in this hardened mass, and then speedily destroys the patient. In other cases, the integuments covering the breast become early contaminated by the cancerous matter assuming a hard, leathery character, or feeling brawny and infiltrated; often without discoloration, but presenting a hypertrophied appearance, the pores being enlarged, and the interspaces between them increased. In other cases the infiltrated skin assumes a brownish or purplish color.

The pain is in many cases but trifling in the early stages of the affection, so much so indeed, that it is the tumor, often accidentally noticed, that first excites alarm; as it increases, however, the suffering becomes severe, more particularly at night, is greatly aggravated by handling the diseased mass, and chiefly extends up to the shoulder and down the arm. The pain usually becomes most severe about the time when the skin is first implicated; but as the

cutaneous infiltration goes on, it gradually lessens, owing probably to the destruction of the cutaneous nerves.

Retraction of the nipple commonly commences about the same time that the skin is implicated; it appears to be owing to the glandular substance becoming involved in the mass of the tumor, and thus giving rise to shortening of the lacteal ducts, in consequence of which, by the projection forwards of the general mass of the breast, the nipple appears to become completely buried This sign has, I think, received more importance than it deserves in connexion with cancer, as it does not occur in all cases of malignant disease, and is occasionally met with in simple mammary tumors.

The axillary glands usually become enlarged early in the disease, and may attain a greater size than that of the original tumor, and on close examination a kind of indurated cord may be felt extending in the course of the absorbents, from the edge of the pectoral muscle to the axilla. After a time the supra or sub-clavicular glands may likewise become complicated. In fact, the whole of the glandular structures in the vicinity of the shoulder undergo cancerous infiltration. When this is the case, the pressure that is exercised upon the axillary vein may occasion œdema of the arm and hand. The glandular infiltration usually increases rapidly after the skin has become implicated.

As the scirrhus extends, it gradually affects the subjacent muscles, cellular tissue, the ribs, and at last the pleura, commonly giving rise eventually to hydrothorax or secondary visceral deposits. In many instances, however, the disease proves fatal by the induction of exhaustion. The constitutional cachexy is in many cases not very distinctly marked, until after the skin has become involved; but then it rapidly increases, more especially when ulceration takes place. Indeed the cancerous degeneration of the skin may be looked upon as an epoch of peculiar importance in scirrhus of the breast, as it is at this period that the pain increases, that the lymphatic system becomes infected, and that the constitution becomes distinctly poisoned.

The duration of life after the occurrence of scirrhus of the breast, varies greatly, so much so that the disease may be considered as assuming an acute and a chronic form. The acute variety principally occurs in ruddy and plethoric women, and commonly proves fatal in a few months. In those who are of a more feeble and delicate constitution, the disease, as a general rule, takes a slower course. Sir A. Cooper states that the disease, on an average, is from two to three years in growing, and from six months to two years in destroying life, after being fully formed. In this estimate, which is probably correct, Dr. Walshe agrees, so that the average duration of life in cancer of the breast would probably be about three years. As a general rule, the progress of scirrhus is slower in old people, in whom it occasionally gives rise to a kind of atrophy of the breast, with shrinking and induration of the tumor. There are many instances on record, however, in which cancer of the breast has existed for a far longer period than has just been mentioned, for ten, twelve, or even as in a case related by Sir B. Brodie, for twenty-five years.

After removal, scirrhus of the mamma presents considerable variety in appearance. In the majority of instances it occurs as a peculiarly hard knobbed and irregular mass, creaking under the knife when cut, and presenting on section a greyish or bluish-grey, semi-transparent surface, traversed in various directions by bands of a more opaque character, and exuding on pressure a thin reddish juice. In many instances masses of an opaque character, and yellowish tint, may be seen in the midst of the tumor. These, which look like tuberculous deposits, consist in reality of fatty degeneration of the scirrhous structure. In other cases again, on pressing the tumor, small drops of a thick creamy fluid will appear to exude at various points. This appears to be the inspissated and altered secretion of the gland retained in the ducts. Cysts are occasionally, though rarely, met with in scirrhus of the breast; these are usually small, and

contain clear fluid, being deeply imbedded in the substance of the tumor; in other cases again, they may be large and globular, and filled with a bloody or dark-green liquid. The microscopical characters of scirrhus of the breast, are such as are represented in fig. 148.

Encephaloid of the mammary gland is by no means of such common occurrence as scirrhus, but yet all the varieties of this form of cancer have been met with in the breast; and fungus hæmatodes has been seen to spring from the bottom of cystoid growths previously developed in this region. Encephaloid of the breast may sometimes acquire a considerable size; thus, Cruveilhier relates a case in which the tumor weighed nearly twelve pounds. The structure of this disease does not differ from that of the same affection in other situations; both the hard and the soft varieties may be met with, and in some advanced cases the true fungous growths occur. Encephaloid usually begins deeply in the substance of the breast, as a soft globular tumor, which rapidly increases in bulk; the integuments covering it are not at first adherent, but are usually pushed before it, and speedily become permeated by a largely ramified net-work of veins. The mass feels as if composed of several soft and rounded tumors, which communicate an obscurely fluctuating sensation, causing perhaps the surgeon to mistake the growth for a cystic formation, or an abscess. The breast now rapidly assumes a very prominent and conical form; the skin covering it at its most projecting part becomes thinned and reddened, and at last gives way, leaving a large circular ulcer, from which a fungous mass of greyish or reddish-brown color speedily sprouts up, with a good deal of discharge of a foul, bloody, and offensive character. From this, disintegrated masses are occasionally detached by a kind of sloughing action, and cases may even occur in which the whole of the fungous protrusion sloughs away, and cicatrization taking place, a tolerably perfect cure may result. These cases, however, are so rare, as scarcely to influence our prognosis of the necessarily fatal character of the affection. Implication of the glandular structures in the vicinity of the tumor, followed by constitutional cachexy, occurs in this as in true scirrhus of the breast. The progress of the disease is always extremely rapid, more particularly in young and otherwise healthy subjects.

Colloid cancer and *melanosis* of the breast occur so rarely, and only in connection with the other varieties of the disease, that they can merely be looked upon as presenting points of pathological interest.

The *causes* of cancer of the breast are usually of an extremely obscure character. The most marked circumstance that influences its occurrence is certainly sex, it being, as is well known, almost entirely confined to women; yet instances in which this affection is met with in the male breast occasionally occur. Its peculiar frequency in the female may possibly be owing to the great and sudden alternations of the functional activity of the breast in women. The changes that are impressed upon this organ at puberty and during pregnancy, the various alternations it undergoes, and inflammatory affections to which it is subject during lactation, the frequent irritation to which it is exposed by sympathizing with uterine derangement, and the diminution in its vital activity that takes place at the change of life, are sufficient to explain the great liability of this organ to disease generally; and may not improbably give a clue to the reason why it is so peculiarly the seat of cancer in women. The age at which cancer of the breast most frequently occurs is between the thirtieth and fiftieth year. According to Birkett, it is most commonly met with between the ages of forty-five and fifty; a period of life that is popularly looked upon as specially obnoxious to this malady. At these ages, cancer of the breast usually affects the form of scirrhus. When occurring, as it very rarely does, in early life, it more frequently assumes the encephaloid character. I have, however, removed a scirrhous breast from an unmarried woman of twenty-three years of age. In elderly women, scirrhus also is the prevalent form, though I have seen two or

three instances of encephaloid at an advanced period of life; one case, in a woman upwards of seventy years of age. Indeed, cancer, in either form, may affect this organ up to the latest periods to which life is prolonged. Married women are said to be more liable than single ones to cancer of the breast; it may, however, fairly be doubted whether they are proportionately so, and it is a common belief, founded, I believe, in some degree on truth, that the disease is most common in those women who have not borne children.

Injuries inflicted upon the breast, such as blows, squeezes, &c., are commonly referred to, and are greatly dreaded by women, as the causes of cancer. That they might be so in constitutions otherwise predisposed to the affection, does not appear improbable, and that they are so in reality, I have not the least doubt. The number of instances that have fallen under my observation, in which a blow or squeeze of the breast has speedily been followed by the appearance of a cancerous tumor in it, leave no doubt whatever on my mind of the truth of the popular belief that associates the injury with the disease, in the relation of cause and effect. Lacteal inflammations are likewise frequently supposed to tend to the production of cancer of the breast. Of this doctrine I think that we do not possess at present sufficient proof, though it appears to me highly probable that disturbances of the functions of the organ during lactation may predispose to the occurrence of this disease.

The *diagnosis* of cancer of the breast from other diseases affecting this organ, is of the first importance, and is attended by corresponding difficulties. The great point is to determine whether the tumor of the breast is of a cancerous character or not; beyond this it matters little in practice that the surgeon should go — and, indeed, except in some of the forms of cystic disease of this organ, few practitioners would feel disposed to endeavor to carry their diagnosis beyond this point. The great and essential difficulty in determining the nature of a tumor of the breast consists in the fact of the same signs being more or less common to many growths in this region; a hard, circumscribed, indolent mass, chronic in its progress, with a certain amount of pain, being the usual characteristics presented by all solid mammary tumors; and though in nine cases out of ten, a tumor presenting these characters, which has existed for a year or more, in an elderly woman, and has resisted ordinary absorbent and alterative treatment, is of a scirrhous character, yet instances of the reverse occasionally occur. Nothing can better exemplify the difficulty of diagnosis in tumors of the breast, than the circumstance, which is not unfrequently witnessed, that after the removal of the diseased mass, its section, and careful examination, surgeons of equal experience will differ as to whether it is malignant or not, and to what class of affections to refer it; and, indeed, in many of these cases it is impossible to ascertain its precise nature without having recourse to microscopical observation.

It is extremely difficult to lay down any definite rules of diagnosis, by which the question as to the malignancy of a tumor of the breast can be solved. In the majority of cases of cystic growth in this region there is little difficulty; the existence of cysts of sufficient size to be readily felt or seen through the skin, being generally characteristic of the malignant cystic growths. It must be borne in mind, however, that cases, such as one to which allusion has already been made, may occur in which cysts are conjoined with cancerous development.

The diagnosis between cystic sarcoma and some forms of cystic cancer of the breast is not always easy, indeed may be impracticable, and can only be determined after removal by microscopical examination. I have lately had a patient in the hospital fifty-nine years of age, in whose breast a hard tumor, as large as half an orange, had existed for five years; it was perfectly and freely movable, unconnected in any way with the skin, there was no retraction of the nipple, and no lancinating pains. On its upper side, several large cysts could be felt, and seen through the skin. On examination after removal, it was found to be

encysted scirrhus, with large cysts, the size of cherries, containing bloody and yellow fluid. The only very suspicious circumstances here were the age of the patient, and the existence of one small indurated gland in the axilla.

In these cases of doubt, the safer plan is always to make an exploratory puncture, and, if necessary, to examine under the microscope the contents withdrawn by the groove in the needle or by the trochar; indeed, if there is the slightest doubt as to the nature of the tumor, this exploratory puncture should never be omitted before its removal is determined upon. I have more than once seen tumors pronounced positively to be scirrhous, and for which amputation of the breast had been recommended, turn out to be cystic, and disappear entirely as their contents were withdrawn.

NON-MALIGNANT TUMORS.	SCIRRHOUS TUMORS.
Feel. — Moderately hard, nodulated, irregular in shape, occasionally more or less lobed, not very distinctly circumscribed, sometimes elastic in parts.	*Feel* of a stony hardness, knobby and distinctly circumscribed, or else somewhat square, and occupying the whole of the substance of the gland.
Mobility is considerable, though occasionally there is a deep pedunculated attachment.	*Mobility* at first considerable, but soon becomes fixed to the deeper structures by a broad attachment.
Skin of the natural color throughout, though thinned and expanded, with the tumor lying close beneath it. Only implicated in the advanced stage of cystic sarcoma.	*Skin* becomes early implicated — at first dimpled, then red or purple, and in other cases brawny and leather-like, so that it does not admit of being pinched up into folds, or nodulated, purpled-red masses form in it.
Nipple usually not retracted.	*Nipple* usually retracted.
Veins of the skin not much dilated.	*Veins* of the skin very greatly dilated.
Pain often moderate, if severe, continuous or of a neuralgic character, much increased by handling.	*Pain* severe and lancinating, especially at night after handling, and when the skin is implicated, but not continuous.
Axillary glands of usual size, or but slightly enlarged and movable. Lymphatics not affected; supra-clavicular glands not affected.	*Axillary glands* enlarged, indurated, and fixed. Indurated mass of lymphatics under and parallel to edge of the pectoral, stretching into the axilla; supra-clavicular glands enlarged.
No constitutional infection.	Constitutional cachexy as disease advances.

Between cancer and the ordinary solid tumors of the breast, the diagnosis is often extremely difficult, but we may arrange the chief signs of the two forms of disease in distinct groups, when, by comparing them together, the differences may be more clearly seen. (See Table, above.)

Treatment of cancer of the breast.—In cases of cancer of the breast, the first question that presents itself to the surgeon, is whether any plan of treatment short of the removal of the tumor holds out a prospect of cure, or even of relief; and if not, whether the extirpation of the cancerous breast can be undertaken with the prospect of ridding the patient of an otherwise fatal disease; or at least of prolonging her existence. To these questions the remarks made at page 406 *et seq.*, on the general treatment of cancer, may be considered applicable. The management of cancer of the breast, however, involves so many special considerations of importance that it becomes necessary to consider its bearings somewhat in detail.

No constitutional means appear to be of the slightest service in arresting, and still less in removing, cancerous tumors of the breast. The advantages stated to have been derived from the use of arsenic, conium, iron, and various preparations of mercury, have not been borne out by experience; and indeed it

may be stated generally that these and all other known remedies are perfectly valueless in the curative treatment of this disease.

Compression by various means, whether by plasters, as employed by Young; by agaric, as used by Recamier; by the spring-pads of Tanchou, or the slack air-cushion of Dr. Arnott, has been much praised, not only as a palliative, but as a curative means of treatment in this disease; and cases are recorded, which, however, even the warmest advocates of this plan of treatment are forced to admit to be altogether exceptional, in which the employment of this means has been stated to have effected a complete removal of the tumor. But although I am not prepared to deny that hard and chronic tumors of the breast may have become absorbed during the employment of this treatment; and indeed I have had occasion to observe this in my own practice, in cases of chronic mammary growth; I think that evidence is altogether wanting to show that an undoubted case of cancer of the breast has ever been cured by this means. And notwithstanding the high authority with which some of these alleged cases of cancer have been brought before the profession, no positive proof has been adduced to show that the tumor that was observed was really and truly of a cancerous character, and that it may not have been either a chronic mammary tumor, or an encysted abscess of the breast. Every practical surgeon well knows that it is utterly impossible in the present state of science to diagnose in many cases with complete certainty the true nature of a tumor of the breast, and must frequently have witnessed cases in which, after extirpation, the morbid growth has been found to be of a different character to what had originally been supposed. I am acquainted with at least eight or ten cases in which some of the most experienced surgeons, both in this country and in Paris, have amputated the breast, for supposed scirrhus, when after removal, it was found simply to have been the seat of a chronic abscess, with very dense walls. And with regard to hard, chronic, and indolent tumors of the breast, few surgeons will hazard a positive diagnosis, as to whether it is of a scirrhous character or not, until they have actually seen a section of it; and even then how often does it not happen that men of equal experience will differ in the judgment they pronounce as to its nature. For these reasons it is impossible not to receive with the utmost hesitation the cases of supposed cancer of the breast reported as cured by the advocates of compression, and not to suspect that the cases recorded by these gentlemen as instances of the successful employment of this plan of treatment, may have been other chronic tumors of the breast, than those of a cancerous character.

But though I think that there is no evidence before the profession to prove the utility of compression as a *curative* agent in cancer of the breast, I think that when practised with Dr. Arnott's slack air-cushion, or Tanchou's spring-pad, it is of considerable value as a palliative in some of the earlier stages of this disease; when it may undoubtedly occasionally arrest its progress for a time, diminish the size of the swelling, and lessen the violence of those attacks of lancinating pain which are so distressing to the patient. In conjunction with the pressure, much relief to suffering may be afforded by the use of belladonna plasters, or of atropine or aconite inunctions, together with the internal exhibition of conium. In the advanced stages of the disease, however, when the skin is involved, the pressure is often unbearable, increasing the pain, and acting as a source of irritation to the patient. In some cases of this kind, in which the slack air-cushion could not be borne, I have seen relief afforded by moderate pressure with thick layers of amadou, supported by an elastic bandage, belladonna or conium in powder being dusted on the innermost layer of amadou. A very thin gutta-percha shield, moulded to the part, may sometimes be advantageously applied over this, and kept on by turns of an elastic roller. When the skin is implicated and very tender, the application of bread poultices made with belladonna and lead lotion is of use. When the disease has run into an

ulcerated stage, the internal administration of conium, so as to blunt the sensibility, and the local application of chlorinated lotions to lessen the fetor, together with the application of the watery extract of opium or of belladonna are of much use. In such cases as these, the application of caustics has been greatly vaunted, and portions of the diseased surface may be cleansed or removed by these means.

Caustics employed in accordance with the principles laid down at p. 407 may occasionally be advantageously employed in the treatment of cancer of the breast, when excision is not practicable.

The constitutional and ordinary local treatment of cancer of the breast being thus, at the most, of a palliative character, the question of operation always presents itself at last. The objects proposed by an operation are in the first place, by the extirpation of the diseased breast, to prevent constitutional infection, and thus permanently to free the patient from her necessarily fatal affection; or, failing in this, to retard the progress of the constitutional infection, and thus at least to prolong existence. How far these objects are attained by amputation of the cancerous breast is a subject of important inquiry to the surgeon. The operation has of late been discountenanced by many excellent pathologists; not so much from any intrinsic danger it may possess, for although occasionally fatal from erysipelas or some similar accidental complication, there is nothing specially hazardous about it; nor from its being now, as formerly, open to the objection of subjecting the patient to unnecessary pain, all suffering during its performance being prevented by anesthetics, and little inconvenience being experienced at subsequent dressings, which are usually of a nearly painless character; but the great objection lies in the fact of the disease, in many cases, returning with equal, and in others perhaps with greater rapidity after the operation, than if none had been performed.

The principal points in connection with the operation appear to resolve themselves into two questions:—1st. Whether, in any cases of cancer of the breast, constitutional infection may be prevented by amputation of that organ; and if so, under what circumstances this will most probably happen? And, 2d. Although the disease may eventually return in the part or elsewhere, whether excision may not arrest the rapidity of the fatal termination?

In answer to the first question, it is not easy to give a very definite reply. Nothing shows more clearly the worthlessness of so-called surgical statistics than the discrepancy that exists between those that have been published as exhibiting the liability to relapse of cancer after operation. Thus, Hill states, that out of 88 cancers on which he had operated at least two years before the return was made, there were only 10 relapses, and 2 deaths; whilst Alexander Munro states, that out of 60 cancers which he had seen removed, in only 4 patients was there no relapse at the end of the second year. Boyer only saved 1 in 25, and Macfarlane gives a still more unfavorable account of his practice; for he says, that out of 32 cases of cancer operated upon by himself, there was not one instance of radical cure; and of 80 other cases that he was acquainted with, the result was in every instance unfavorable. Warren, on the other hand, saved one in 3; and Cooper 1 in 4. Amidst such conflicting statements as these, it is clearly impossible to eliminate more than the general fact which is well known to every surgeon, that in a large number of the cases of cancer that are operated upon, there is a tolerably speedy return of the disease. In these cases there are, however, many points to be taken into account, that gross statistics can take no cognizance of; much being necessarily dependent upon the skill with which the operation is performed, as well as upon the care employed by the surgeon to cut widely of the disease, and to extirpate completely not only the whole of the morbid mass, but those tissues in its neighborhood that might be supposed to be implicated.

In many of the cases, also, it is by no means improbable that the practice, at

one time pretty generally followed, may have been adopted, of merely extirpating the tumor without removing the whole of the breast. I am, therefore, disposed to look upon any deductions based upon the statistics of such men as Hill, Macfarlane, and Benedict as of very little value when applied to the surgery of the present day.

It would, however, appear from the result of those inquiries, that in a certain proportion of cases, whatever the precise ratio be, and this is still undetermined, the disease may be effectually removed by extirpation of the breast.

As the second question, — whether as a general rule life may not be prolonged by the performance of the operation,—it would appear, if the statistics collected by Leroy D'Etiolles are accurate, that hitherto it has not. Dr. Walshe comes to the conclusion that the operation cannot as a general rule be regarded as a means of prolonging life, but that in the majority of cases death is hastened by such interference. Sir A. Cooper and Sir B. Brodie both agree that in the majority of cases, the disease returns in two or three years after the operation, and then kills the patient.

But though the general result of a statistical inquiry into this subject, based upon the imperfect materials and probably very incorrect figures at present before the profession, leads to the conclusion that operations for cancer of the breast, when indiscriminately performed, have hitherto not only failed to cure the disease, but actually in a great number of cases hastened its fatal termination, yet it must be borne in mind that instances do occur in which life is certainly prolonged by this means considerably beyond its average duration in cancer of the breast. Thus, Callaway operated on a case in which no return took place for twenty-two years. Velpeau states that he has removed encephaloid tumors of the breast, and that the patient has remained free from the disease for eight or ten years. Sir B. Brodie and other surgeons relate similar instances in which the patient's life has been prolonged after the performance of the operation; and the experience of the most eminent practical surgeons is decidedly in favor of having recourse to it under certain circumstances.

The only reliable statistics that we possess on the relative duration of life in cases of cancer of the breast, with or without operation, are those collected by Mr. Paget. He states that of 139 cases, 75 were not submitted to operation; of these the average duration of life was 48 months. Of 64 operated on the corresponding average has been a little more than 52 months. In the first two years of the disease the proportion of deaths was much less in those operated on than in those who were left, — being in the former less than 11 per cent., in the latter more than 30 per cent. The longest duration of life in a case not operated on was 18 years; in those operated on, a little more than 12 years.

There is, however, another point of view from which these operations may be considered; for even if they do not prolong life, they may greatly improve the patient's condition, and place her in a state of comparative comfort during the remainder of her existence. Thus she may be suffering so much pain from the local affection, or if it be ulcerated, be so much affected by the fetor of the discharges, that she may be placed in a position of far greater comfort by having the local source of disease and irritation removed; and though she die eventually of cancer, it may be with much less suffering to herself and others for her to be carried off by secondary deposits in the lungs or liver, than to be worn out by the external affection.

In considering the propriety of operating in cancer of the breast, it is of the utmost importance to determine those cases in which the operation may possibly be the means of preserving or prolonging life, from those in which there is no prospect of its being of any service, or in which indeed it must inevitably hasten the patient's death. Whatever the value of statistics may be in determining the question as to whether in cases of cancer of the breast generally, the opera-

tion will effect a cure or prolong life, they are not equally valuable in their application to individual cases. When a surgeon is called for his opinion respecting the propriety of amputating the breast of the patient before him, it is not sufficient for him to be able to state what the general result of the operation may be, but he must be able to satisfy himself whether the particular instance under consideration may not be one of those cases, exceptional perhaps, in which there is a fair probability of the operation extirpating the disease entirely from the system, or at all events prolonging the patient's existence. In order to do this it is necessary to endeavor to lay down some rules that may guide us in selecting those cases in which the operation may be advantageously done, and in setting aside others in which we know that it will almost to a certainty hasten the patient's death. And indeed it is the absence of all such considerations in general statistical investigations into the results of operation for cancer, that deprives them of much of their value as guides in actual practice.

Though nothing can be more unsurgical or improper than the indiscriminate extirpation of all cancerous tumors of the breast from every patient who may present herself, in whatever stage of the disease; and though such a practice would doubtless be followed by fully as disastrous results as those that occurred to Macfarlane, Benedict, and others; yet there can be little doubt that a surgeon who would employ a certain principle of selection, would obtain a very different and far more successful result in his practice. Sir B. Brodie has very clearly and succinctly pointed out the most important circumstances by which the question as to the propriety of operating in these cases should be determined. Before doing so, he very justly dwells on the fact that in many cases the operation may fail, and the disease speedily recur through the negligence of the surgeon in leaving behind portions of the gland, slices of the tumor, or contaminated tissues, and that thus the operation may receive discredit, for what is in reality the fault of the surgeon who performed it.

With reference to operations, cancerous diseases of the breast may be divided into three classes: — 1st. Those in which it is the duty of the surgeon to discountenance excision; 2d. Those in which operation is of doubtful expediency; and 3d. Those in which it is the duty of the surgeon to recommend it.

1st. *Cases unfit for operation.* — In this class we may include the following conditions: (1) Those cases in which there is strongly-marked constitutional cachexy; (2) When both breasts are involved; (3) When there are secondary deposits in internal organs; (4) When the glands under, and especially above the clavicle are much enlarged; (5) If the tumor be adherent to the ribs and intercostal muscles; (6) When the skin is hard, brawny, and infiltrated, of a reddish-brown color, having a hard, leathery feel, or a greasy, glazed appearance; (7) If the tumor is rapidly growing in a patient with a strong hereditary taint; (8) If extensively ulcerated and fungating.

2d. *Doubtful cases.* — (1) If the patient is aged, weak, or anemic, and the tumor large, it is seldom expedient to operate, as the shock may destroy life; (2) When the skin is merely dimpled in by a kind of pedicle passing from the tumor to its under surface, an operation may be performed unless other circumstances should contra-indicate it, but in such cases it is necessary widely to excise the integument surrounding the attached point. The cancer cells, as I have more than once had occasion to observe, will be found to have diffused themselves extensively through the neighboring skin, which, to the naked eye and to the touch, has a perfectly healthy appearance, the tumor being surrounded by a kind of halo or atmosphere of cancer infiltration; (3) When there is but moderate enlargement of the axillary glands, which are so situated as to admit of removal, the operation may be performed; (4) When the cancer is ulcerated, it is seldom proper to operate, but if all other conditions are favorable, this even need not in some special cases be a bar. As Sir B. Brodie has pointed out, the

patient's existence may sometimes in these cases be prolonged, and her comfort materially increased, by the removal of the diseased and ulcerated mass.

3d. *Cases admitting of operation.* — The exclusion of all the cases that fall under the preceding categories will necessarily limit very materially those in which an operation may be undertaken; it can, however, be performed with every prospect of its being advantageous to the patient, if the tumor be of moderate size, slow or nearly stationary in its growth, unconnected with or at least merely attached by a pedicle to the skin, pretty distinctly circumscribed, movable on the subjacent parts, and not complicated by enlarged glands in the axilla or elsewhere. The patient has an especially good prospect of recovery, according to Brodie, if the disease be seated in the nipple. In all cases when an operation is undertaken, the whole of the breast should be removed, and the contiguous tissues pretty widely excised. The integuments being loose in this situation, readily come together even after considerable loss of substance. When the tumor is pediculated, only being attached to the gland at one point, some surgeons have recommended that it alone should be extirpated, the breast being left. This practice, however, is not a safe one; I have seen it followed by a speedy relapse, and should certainly always be disposed to extirpate the whole of the organ in this, as in every case of cancer of the breast.

When once a tumor of the breast has been ascertained to be of a cancerous character, the sooner it is removed the better, unless one of the special reasons adverse to operation that have just been adverted to should exist. I cannot conceive that any good can come of delay in these cases. The disease (for reasons stated at p. 410) appears in the early stages often to be entirely local; there is no evidence of constitutional infection, but if the operation be delayed the skin speedily becomes implicated, the axillary glands enlarge, and cancerous cachexy sets in. When the operation is performed, the whole of the breast and the surrounding cellulo-adipose structures should be freely removed, as there is often a halo of cancer deposit around the morbid mass, in tissues apparently healthy.

Relapse of cancer after operation may take place in two ways; either in the vicinity of the part operated upon, or in some internal organ. When recurring in the neighborhood of the previously affected part, it is probably owing to the cancer-cells having diffused themselves so widely into the skin, the subcutaneous cellular tissue and muscles, or neighboring lymphatic glands, that after the removal of the tumor these cells become the germs of new growths. Under these circumstances it may recur in the cicatrix and then implicate the glands; or, in the glands, without the cicatrix having been previously affected. In local relapse of this kind, it often happens that the disease so reproduced, runs its course more rapidly than if no operation had been done; the increased action set up in the part during the healing process appearing to give augmented force to the reproductive energy of the cancerous growths. In some cases it even returns in the cicatrix before cicatrization is completed, the ulcerated surface then assuming the ordinary character of the cancerous ulcer. In other cases some weeks or months after the cicatrix is fully formed, it assumes a dusky red or purplish tinge, becoming hard, stony, and nodulated at points; these nodules being round or oval, often very numerous, and varying in size from a pin's head to a pigeon's egg, studding the whole length and breadth of the cicatrix, and at last running into true cancerous ulceration. Under such circumstances as these the only hope of prolonging the patient's life lies in the speedy excision of the whole of the diseased structures, provided there be no deep affection of the glands, or evidence of internal secondary deposit. But if the axillary glands be much enlarged, either alone or together, with recurrent disease in the cicatrix, or if there be any sign of internal cancer, further operations will be improper.

AMPUTATION OF THE BREAST.

The operation for the removal of a breast, whether affected with cancer or other disease, may be performed in the following way:—The patient should lie upon a table, with the arm hanging over the side, and held by an assistant. If the tumor be large, and the loss of blood a matter of much consequence, another assistant should compress the subclavian artery on the first rib. If the veins about the part be much dilated, measures should be taken to arrest the flow of blood from them, as it may sometimes be dangerously profuse; indeed, South relates the case of a patient who died from this cause, during the operation. An oblique elliptical incision, of sufficient length, should then be made, first below, and next above the nipple, so as to include a sufficient quantity of integument. The dissection should then be rapidly carried down, by a few strokes of the scalpel, to the pectoral muscle, and the breast removed from the cellular bed in which it lies. Some surgeons extirpate the breast by a perpendicular, others by a transverse incision. I think that an oblique incision following the course of the fibres of the great pectoral is most convenient, as it enables the surgeon, if necessary, to extend the cut into the axilla for the removal of enlarged glands, and after cicatrization, allows of the movements of the arm without undue traction. After the removal of the diseased breast, it and the tumor, as well as the whole interior of the wound, must be carefully examined, in order to ascertain that no slices of morbid tissue have been left behind; if so, they must be freely cut out, and if, as sometimes happens, the growth is rather firmly adherent to the pectoral muscle, or subjacent structures, portions of these must also be removed. Should it be found that there are any enlarged glands in the axilla, they may be extirpated, either by extending the wound upwards in this region, or by making a separate incision into the axilla, and carefully dissecting them out. In doing this, the edge and point of the scalpel should be very carefully used, and the glands rather teased out with the handle of the knife and fingers, so as to avoid the risk of hemorrhage, which is apt to be troublesome in this situation. The extirpation of enlarged axillary glands is the most troublesome part of operations on the breast, as they often extend much higher into the axilla, and under the edge of the pectoral than would at first appear. When exposed, they may be seized with a double hook or artery-forceps well drawn down, and then enucleated as far as practicable with the fingers, aided by a few cautious touches with the edge of the knife. The less the point is used deep in the axilla, the better for the patient. Should the glandular mass extend high up, coming into close relation with the axillary vessels, it would not be prudent to attempt its complete extirpation with the knife, but having been separated as far as practicable in the way already mentioned, it should be well drawn down, and then tied tightly as high as possible with a piece of whipcord, all that portion below the noose being then cut off. In this way the two great dangers that attend the extirpation of tumors in this locality, that are deeply situated and out of sight, viz., hemorrhage and the entry of air into dilated veins, may be avoided, and the ligature being applied beyond the diseased mass, that which remains of it will slough away when the thread separates. During the operation itself all hemorrhage may be controlled by pressure on the subclavian above the clavicle.

It occasionally happens that tumors are met with in the axilla as a primary disease, unconnected with any malignant or other morbid action, either in the upper extremity or the breast. Such masses may either be of a strumous or cancerous nature, and require extirpation. When strumous, they are readily enough enucleated; but when cancerous, they become so widely and deeply adherent that their removal cannot be undertaken without much danger. In

such dissections as these, I have had occasion to expose the axillary and subscapular vessels to some extent.

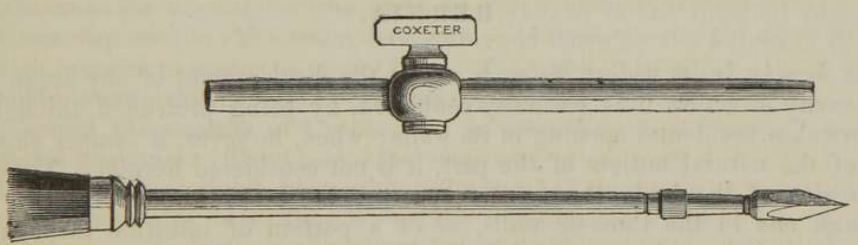
After any bleeding vessels have been ligatured, the incision through which the breast was taken out may be brought together by a few points of suture, and supported by a bandage, so as to prevent bagging of matter. In many cases it will unite by the first intention, for, owing to the yielding nature of the parts in this situation, the lips of the cut come into very good apposition, even though a considerable mass has been removed. By some it has been supposed that relapse of cancer is less liable to take place if the wound unite by granulation, than if it come together by more speedy union; of this, however, there is at present no proof with which I am acquainted, though it is by no means improbable that the suppurative action may eliminate cancer-cells from the neighboring tissues.

The *male* breast, though very rarely the seat of disease, may occasionally become affected in a somewhat similar manner to the mammary gland in the female; being in some instances hypertrophied, in others, the seat of an abnormal secretion of milk, and, in other cases, affected by the formation of cysts, encysted, and scirrhous tumors. These growths require removal by the same kind of operative procedure that is adopted when they affect the female breast, though of a less extensive character.

TAPPING THE CHEST.

Paracentesis thoracis may best be done with an ordinary trochar of moderate size, and the most convenient spot for the puncture is usually the side of the chest in the fifth intercostal space, at the line of insertion of the serratus magnus. The skin having been punctured with a scalpel, the trochar should be pushed over the upper margin of the sixth rib into the middle of the space, so as to avoid the intercostal artery, and must then be thrust sharply and boldly

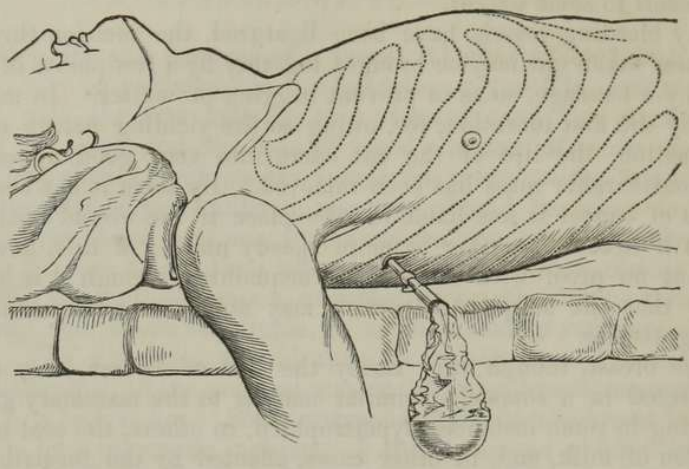
Fig. 304.



into the pleural sac, so as to make sure of perforating any false membranes that may line its interior, and which, if the instrument be pushed slowly on, might be carried before it, and thus prevent the escape of the fluid. Air may in this operation gain entrance into the pleura, and, decomposing the pus, become a source of irritation. In order to obviate this inconvenience, the instrument figured in the accompanying sketch (fig. 304) will be found useful; the trochar having been introduced, and the stop-cock shut, as the piston-stylet is withdrawn a bladder is attached to the end of the canula, and when this has been filled the stop-cock is again closed, the bladder emptied and reapplied (fig. 305). In this way as much of the fluid as is desired may be removed. After the withdrawal of the canula, the puncture is closed by a pad of lint, strapping, and bandage. After tapping, the lung will either expand, and fill up the cavity previously occupied by the fluid, or if adhesions prevent this, the thoracic parietes will gradually collapse.

In hydrops pericardii, the pericardium may be tapped by making an incision

Fig. 305.



through the skin and cellular tissue in the fifth intercostal space, and then puncturing the membrane with a fine trochar at that point where palpation and auscultation have indicated the greatest amount of fluid. The trochar should be passed obliquely.

DISEASES OF THE ABDOMEN.

CHAPTER LIII.

HERNIA.

By *hernia*, in its widest sense, is meant the displacement of any organ from the cavity in which it is naturally contained, by being protruded through an abnormal or accidental opening in its walls; when, however, it escapes through one of the natural outlets of the part, it is not considered hernial. Thus, the protrusion of the brain through an aperture in the cranium, or of the lung through one in the thoracic walls, or of a portion of intestine through the abdominal parietes, is termed a hernia of these organs; but the descent of the bowel through the anus does not come under this designation. Here, however, we have only to consider the hernial protrusions that occur in the abdomen — the common situation of this disease.

A hernia may occur at almost any part of the abdominal wall, though it is far more liable to do so in some situations than in others, being commonly met with at those points where the muscular and tendinous structures are weakened to allow the passage of the spermatic cord in the male, and of the round ligament in the female; or for the transmission of the large vessels to the lower extremity; hence the inguinal and crural canals are the common situations of this disease. It may, however, occur in various other situations, as at the umbilicus, the thyroid foramen, the sciatic notch, in the vagina, the perineum, through the muscular portions of the abdominal wall, the diaphragm, etc.

In whatever situation it occurs, a hernia is composed of *a sac* and *its contents*. The *sac* is the prolongation of that portion of the perineum which overlies and corresponds to the aperture through which the hernia protrudes, and is in all

cases composed of a neck and body. The neck is usually narrowed, though in some old herniæ it becomes wide and expanded: it is commonly short, consisting indeed of a sudden constriction of the sac in this situation, as happens in many forms of femoral hernia; but in other cases it is elongated, narrowed, and thickened, and even vascular in its structure. The neck of the hernial sac usually becomes greatly thickened, and of an opaque color, in consequence of the deposition of plastic matter in or upon it, from the irritation to which it has been subjected by the pressure of the hernial tumor or the truss, from the incorporation of the subserous cellular tissue that lies external to it, or by the puckering together of its folds, which have been compressed by the aperture in which it lies. The body of the sac varies greatly in shape and size, being usually globular or pyriform, sometimes elongated and cylindrical; it may vary from the size of a cherry to a tumor as large as the head. When recent, it is usually thin and transparent, though in some cases it becomes greatly thickened, having arborescent vessels ramifying on it, and being almost laminated in structure; this is especially the case in old femoral herniæ. In other instances, however, it becomes thinned and atrophied as the tumor expands, so that the contents become visible through it. This is especially the case in old umbilical herniæ, in which I have seen it as thin as the finest gold-beater's skin. In some cases the hernial sac undergoes degeneration, becoming converted into a fibrous or even calcareous layer.

The sac, though usually forming a perfect inclosure to the hernial contents, occasionally constitutes but a partial investment to them, more particularly in such organs as the cœcum or bladder, which are naturally partially uncovered by the peritoneum. In other instances, again, it may be ruptured, or altogether absent; more rarely a double hernial sac is met with, one being protruded into or placed behind the other. There are instances of three sacs occurring together, and Sir A. Cooper even relates a case in which six were met with in the same person.

The abdominal parietes outside the sac undergo important changes. The aperture through which the hernia protrudes usually becomes circular; after a time, indurated and rounded at the edge, and considerably enlarged; when situated in the movable portions of the abdominal wall, as in the inguinal regions, it becomes displaced in old herniæ, being dragged down by the weight of the protrusion, usually towards the mesial line. The subserous cellular tissue always becomes greatly thickened, often indurated and fatty, so as to constitute one of the densest investments of the sac, and, in some old cases of hernia, closely to resemble omentum. The more superficial structures, such as the integument and fascia, become much elongated and stretched; often tense, but not unfrequently hanging in folds; they are usually thinned, but if a truss has been long worn, they become thickened and condensed by the pressure of the pad.

The *contents of the sac* vary greatly, every viscus except the pancreas and stomach having been found in hernial tumors. Most frequently a portion of the small intestine, more particularly of the ileum, is protruded, constituting the form of hernia called *enterocele*. The quantity of intestine within the sac may vary from a small section of the calibre of the gut, the whole diameter not being included, to a coil several feet in length, with its attached mesentery. After a portion of the intestine has once descended, the protruded part tends to increase in quantity, until, as in some large and old herniæ, the greater portion has been known to lie in the sac. The large intestine is rarely found in a hernia, though the cœcum is occasionally met with. When intestine has been long protruded, it usually becomes thickened in its coats, and narrowed, greyish on the surface, and more or less deranged in its functions. The corresponding mesentery becomes thickened, hypertrophied, and vascular.

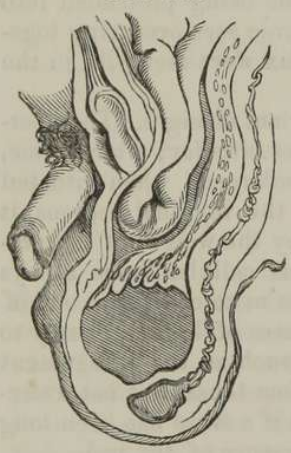
Omentum is often found in hernial sacs, together with intestine, but is not unfrequently met with alone, constituting the disease called *epiplocele*. After

having been protruded for some time it becomes thickened, brawny, and laminated, losing its ordinary cellulo-adipose texture, and becoming indurated. Its veins usually assume a somewhat varicose condition, and the mass of omentum acquires a triangular shape, the apex being upwards at the abdominal aperture, and the base below broad and expanded. In some cases it can be unfolded, in others it is matted together into a cylindrical mass. Occasionally apertures form in it, through which a coil of intestine may protrude, thus becoming secondarily strangulated within the sac. In other instances cysts are met with in it containing fluid; or into which the intestine may even slip. When intestine and omentum together are found in a hernia, the disease is termed an *entero-epiplocele*, and under these circumstances the omentum usually descends before, and occasionally envelops the intestine. Besides these the ordinary contents of herniæ, the stomach, liver, spleen, sigmoid flexure of the colon, bladder, uterus, and ovaries, have all been found in them.

Adhesions commonly form within the sac in old standing cases. These may take place between the contained viscera merely, as between two coils of intestine, or between these and the omentum; or they may form between the wall of the sac and its contents, either by broad bands, or else by bridging across from one side to the other, and enclosing a portion of the viscera. In recent cases these adhesions are soft, and may readily be broken down; but when of longer duration they are often very dense, and are especially firm about the neck of the sac.

Besides the viscera, the hernial sac always contains a certain quantity of fluid secreted by and lubricating its interior. In most cases this is in but small quantity, but in some instances, when the sac is inflamed, or the hernia strangulated, a very considerable bulk of liquid has been met with; I have seen as much as a pint escape from a large hernia in an old man. When abundant, it is generally of a brownish color, though clear and transparent, and is met with in largest quantities in inguinal herniæ. In some instances this fluid becomes collected in a kind of cyst within the sac formed by the omentum contracting adhesions to its upper part, and leaving space below for the fluid to collect, in which this accumulates between the omentum above and the wall of the sac below; this condition, represented in the annexed figure (306), has been called *hydrocele of the hernial sac*, and constitutes a somewhat rare form of disease. The fluid is often in considerable quantity; in a case which I tapped some years ago, nearly three pints of dark brown liquid had thus accumulated, and were drawn off.

Fig. 306.



If we limit the term *hydrocele of the hernial sac* to those cases in which there is a slow and gradual accumulation of fluid at the bottom of an old hernial sac, which has been cut off from all communication with the peritoneum either by the radical cure of the hernia, or by the adhesion of intestine or omentum to the upper part and neck of the sac, it must be considered a disease of unfrequent occurrence, and but few cases are recorded by surgical writers. Mr. Curling, in his work on the Testis, states that during his connection with the London Hospital, he has seen only one case; and the only others with which I am acquainted, besides one that occurred in my own practice, are two related by Pott, two by Pelletan, one by Boyer, and one by Lawrence. This disease must not be confounded with the accumulation of fluid, in whatever quantity, in strangulated hernia, or in hernial sacs that communicate with the peritoneal cavity. Its distinguishing feature is the accumulation of fluid in a sac that has been cut off from all communication with the cavity of the peritoneum.

The *symptoms* of hernia, though varying considerably according to the contents of the sac and the condition in which it is placed, present in all cases many points in common. Thus there is an elongated or rounded tumor at one of the usual abdominal apertures, broader below than above, where it is often narrowed into a kind of neck; usually increasing in size if the patient stands, holds his breath, coughs, or makes much muscular exertion. It can be pushed back into the abdomen on pressure or goes back readily if the patient lies down, but reappears when he stands up. On coughing, a strong and distinct impulse may be felt in it.

When the hernia is altogether intestinal, it is usually smooth, gurgling when pressed upon, and sometimes tympanitic and rumbling. It may be returned into the cavity of the abdomen with a distinct slip and gurgle; it has a well-marked impulse on coughing, and is usually accompanied by various dyspeptic symptoms, and often with a good deal of dragging uneasiness.

The omental hernia is usually soft and doughy, returning slowly on pressure into the abdomen, feeling irregular on the surface, and having an ill-defined outline. It occurs most frequently on the left side, and is rare in infants, in whom the omentum is short. In entero-epiplocele there is a combination of the two conditions and their signs; but these are usually so uncertain, that few surgeons care to predict before opening the sac what the probable nature of the contents may be.

Cæcal hernia necessarily only occurs on the right side. It is a large, knobby, and irregular tumor, irreducible, owing to the adhesions contracted by that portion of cœcum which is uncovered by peritoneum. The peculiarity of these herniæ consists in the sac being absent, or only partial in the majority of cases, owing to the peritoneum stripping off as the gut descends. When these herniæ are large, and partially invested by serous membrane, a sac usually exists at their upper aspect, into which a portion of small intestine may fall, and which may in some cases constitute a second hernia lying above or before the cœcal one, which will be found situated at the posterior wall when this hernial pouch is opened. Occasionally the vermiform appendix and the caput-coli are found in the sac, but can rarely be returned. The rule of cœcal herniæ only having a partial peritoneal investment, does not hold good in all cases; and instances have occasionally been met in which this portion of intestine lay in a distinct sac.

Hernia of the bladder or *cystocele* is of very rare occurrence; and, like that of the cœcum, is usually enclosed in a partial peritoneal investment, though it is not necessarily so. South states that there is a preparation at St. Thomas's Hospital, in which the fundus of the bladder, with its peritoneal covering, has passed into a distinct sac. In some instances the cystocele is accompanied by an enterocele. These herniæ are always irreducible, and are attended by a good deal of difficulty in urinating, with varying tension, according to the quantity of fluid they contain; by squeezing them, urine may be forced out through the urethra, and fluctuation has been felt in them. Urinary calculi have been formed in these tumors, and have been removed by incision through the scrotum, or have ulcerated out.

The *causes* of hernia are usually sufficiently well marked. In some instances, the disease is congenital, arising from preternatural patency of the abdominal apertures; in other cases, again, it occurs at a later period of life, in consequence of some forcible effort, as in lifting a heavy weight, jumping, coughing, straining at stool, or in passing water through a tight stricture. It is especially apt to occur from such causes as these in tall and delicate people, more particularly in those who have got a natural disposition to weakness, or bulging of the groins. The displacement of the abdominal viscera by a gravid uterus, will also occasionally give rise to the disease. Hernia is especially apt to occur from a combination of causes: thus, if an aged person, one with a feeble organization,

or whose abdominal apertures have been patent in consequence of rather sudden emaciation, makes a violent effort, a hernial protrusion is very apt to occur.

Amongst the most frequent predisposing causes of hernia are certainly sex, age, and occupation. Men are far more liable to this disease than women. Thus, according to Malgaigne, in France one man in thirteen and one woman in fifty-two, are the subjects of hernia. But, though men are more generally liable to hernia than women, they are less so to certain forms of the disease, especially to the femoral and umbilical. It is to the inguinal that they are particularly subject, although old women very commonly suffer from this form. According to Mr. Lawrence, out of 83,584 patients who applied to the City of London Truss Society, 67,798 were males, and 15,786 females; for the interesting statistical account of the relative frequency of the different kinds of rupture, deduced from the foregoing figures, I would refer to Mr. Lawrence's most excellent Treatise on Hernia, 5th ed. p. 11.

Age exercises a very material influence upon the frequency of hernia. Malgaigne, who has carefully investigated this subject, finds that in infancy the disease is sufficiently common, owing to the prevalence of congenital hernia at this period of life; and, that in the first year after birth hernia occurs in the proportion of 1 in every 21 children. It then goes on decreasing in frequency, there being 1 in 29 at the second year; 1 in 37 at the third year; until, at the thirteenth year, it has fallen to 1 in 77. Shortly after this, its frequency begins to rise again, and then goes on progressively increasing until the close of life; thus, at the 21st year, there is one case in 32; at the 28th year, 1 in 21; at the 35th, 1 in 17; at the 40th, 1 in 9; at 50, 1 in 6; from 60 to 70, 1 in 4; and from 70 to 75, 1 in 3. In women, hernia most frequently occurs from the 20th to the 50th years. Those occupations in which the individual is exposed to violent muscular efforts, more particularly of an intermitting character, predispose strongly to the occurrence of hernia, and in these employments the tendency to the disease is often greatly increased by the injurious habit of wearing tight girths or belts round the waist, which, by constricting the abdomen, throw the whole pressure of the abdominal contents upon the inguinal regions.

The conditions in which a hernia may be found, are very various, and entail corresponding differences in the result and treatment of the affection. When first formed, most herniæ may be said to be *incomplete*, being for a time retained within the orifice of the canal through which they eventually protrude; when they have got altogether beyond the abdominal walls, they are said to be *complete*, and this is the condition in which they are usually presented to the surgeon.

A hernia is commonly at first *reducible*, that is to say, it may readily be pushed back into the cavity of the abdomen, protruding again when the patient stands up, holds his breath, or makes any exertion, and having a distinct and forcible impulse on coughing. Though the hernial contents, in these cases, are reduced into the abdomen, the sac is not; it almost immediately contracts adhesions to the cellular tissue, by which it is firmly fixed in its new situation, though in some particular cases, as we shall hereafter see, it may be pushed back.

In the *treatment* of a reducible hernia, our object is by the application of a proper truss, to retain the protrusion within the cavity of the abdomen. In order to do this, the patient must be provided with a proper kind of truss, adapted to the particular nature of the hernia. Amongst the best are, I think, Salmon and Odys', or Tod's, for inguinal hernia, and the Mocmain for the femoral. In umbilical and ventral ruptures, an elastic pad and belt may most conveniently be used. In selecting these trusses, care should be taken that the spring is of proper strength, adapted to the size and power of the individual, and that it be properly shaped, so that it does not touch any part of the abdominal wall, but merely bears upon the points of pressure and counter-pressure.

The pad should be convex, and firmly stuffed, and of sufficient size to press not only upon the external aperture, but upon the whole length of the canal. Before applying the truss, the hernia must be reduced, by placing the patient in the recumbent position, relaxing the muscles by bending the thigh upon the abdomen, and pressing the tumor back in the proper direction; the truss should then be put on, and be worn during the whole of the day; indeed, the patient should never be allowed to stand without wearing it. At night, it may either be left off altogether, or a lighter one applied. In some cases the skin becomes irritated by the pressure of the pad; under these circumstances, an elastic air-cushion may be used, or the parts subjected to pressure may be well washed with spirit lotion. The truss may be known to fit by testing it in the following way. The patient should be made to sit down on the edge of a chair, and then extending his legs, opening them widely, and bending the body forwards, cough several times. If the hernia do not slip down behind the pad on this trial, we may be sure that the truss is an efficient one, and will keep the rupture up under all ordinary circumstances.

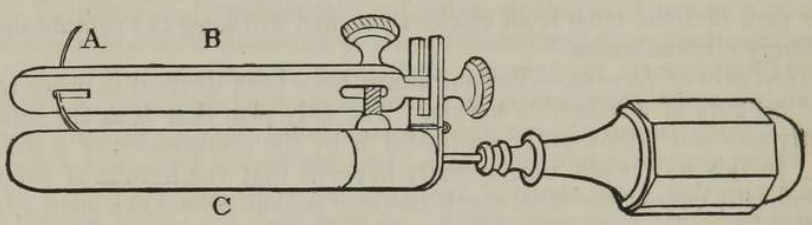
Radical cure of Hernia.—Various means have been devised in order to effect the radical cure of a reducible hernia. The only plan that is at the same time perfectly safe and permanently successful is by the compression of a well-made truss. In this way it not unfrequently happens that the herniæ of infants become radically cured; the same result however seldom occurs at a more advanced period of life. In order that compression should succeed in this way, it is necessary that it should not only be applied to the external aperture through which the rupture escapes, but to the whole of the canal. It must also be continued for a very considerable time, for at least a year or two, and care should be taken that during the treatment the rupture is not allowed to descend; every time it comes down, any good that may have been derived is necessarily done away with, and the treatment has to begin, as it were, anew. After the cure is supposed to have been effected in this way, the application of the truss must be continued for a very considerable length of time, lest by any unfortunate movement the rupture descend again.

The operations that have been devised for the radical cure of hernia are all founded on one of two principles, viz., the excitation of such an amount of peritonitis in the sac, or its neck, as to secure its obliteration, or the plugging of the hernial aperture by invagination of the integumental tissues.

If the accomplishment of these conditions would always prevent the recurrence of the rupture, the radical cure might frequently be undertaken. But it is impossible to look upon the agglutination of the walls of the sac, or the closure of the abdominal aperture, as the sole conditions required. To accomplish the radical cure, it would be necessary in many cases to effect changes in the shape and connections of the abdominal contents, to alter the size of the abdominal cavity, and indeed to modify in various ways many conditions independently of those immediately connected with the hernial protrusion. Many of the means of radical cure, by which obliteration of the interior of the sac or its neck is sought to be effected by the application of sutures or ligatures, the introduction of caustics, its excision, scarification, puncture, or injection with tincture of iodine, are attended with so much danger from peritonitis, and so seldom by any good results, that their consideration need not detain us here. The same remark applies to the attempt to obliterate the canal through which the hernia protrudes, by invaginating and stitching into it a portion of the neighboring integument, which operation, though much cried up, especially by some of the continental surgeons, who have extensively practised it, has been found very seldom to be attended by any permanently beneficial results; the invaginated portion of tissue speedily yielding to the outward pressure of the viscera, allowing recurrence of the hernia to take place. Of late years, however, Wützer, of Bonn, has adopted a plan of radically curing reducible inguinal

herniæ, which combines the two principles on which the older operations were founded, viz., the agglutination of the neck of the hernial sac by the excitation of inflammation in it, and the closure of the inguinal canal by the invagination of the scrotum; and he carries out these objects in a safer and more successful manner than by any of the methods previously employed. This plan of treatment consists in introducing a plug of the scrotum into the inguinal canal, and fixing it there by exciting adhesive inflammation in the neck of the sac. The details of the operation are as follow: The patient lying on his back, and the hernia being reduced, the surgeon pushes his index-finger up the inguinal canal as high as the internal ring, carrying before it a cone of the scrotal tissues; a box-wood hollow cylinder, about four inches long (fig. 307 C), well

Fig. 307.



oiled, is then pushed up as the finger is withdrawn, so as to occupy its place in the inguinal canal. Along the interior of this cylinder a flexible gilt-steel needle (A), fixed in a movable handle, is then pushed, so as to traverse the invaginated scrotum, the hernial sac, and the anterior abdominal wall, through which its point is caused to protrude. A concave box-wood case (B) is then passed over the projecting point of the needle, and fixed by the other end by a screw apparatus to the cylinder (C), so as to compress the inclosed tissues. The apparatus so fixed is left *in situ* for six or eight days, when some discharge being established, it is withdrawn, and the invaginated scrotal plug supported by lint introduced up its interior, and by a spica bandage. The patient is kept quiet for a fortnight longer, when he is allowed to move about, wearing a light truss for three or four months.

This method of treatment is easy of execution, and appears to be more successful than any that has preceded it. And yet it is open to the objections that attend all plans for the radical cure of hernia, viz., the possible excitation of a dangerous amount of peritonitis, and the want of adhesion between the lower part of the scrotal plug and the corresponding part of the inguinal canal and ring. It should of course not be employed indiscriminately, but only in those cases in which, from the laborious nature of the employment and the otherwise good health of the patient, the radical cure may fairly be attempted.

Irreducible herniæ are usually of old date, and large size. They generally contain a considerable quantity of thickened omentum, as well as intestine and mesentery. In many instances, a rupture of this kind is partly reducible, the greater portion remaining behind. It is usually the gut which slips up, and the omentum that cannot be returned. The irreducibility of a rupture may either be owing to its shape, to the existence of adhesions, or be dependent on its very nature. If the sac become the seat of an hour-glass contraction, or its neck become elongated and narrowed, the hernial contents may continue permanently protruding. So also the expanded condition of the lower part of the omentum, and the narrowing of its neck may prevent a return of the rupture. The existence of adhesions, either between the sac and its contents, or between protruded intestine and omentum, will commonly render a hernia irreducible; and most frequently these are associated with changes in the shape

of the sac or the omentum. Herniæ of the cœcum and bladder can never be returned, on account of the anatomical conditions, to which reference has already been made.

An irreducible hernia is usually a source of great inconvenience; it has a tendency to increase if left to itself, until at last it may contain, as in some extreme cases it has been found to do, the greater portion of the abdominal viscera, forming an enormous tumor, inconvenient by its size and weight, in which the penis and scrotum are buried. Even when the irreducible hernia is of small size, it gives rise to a sensation of weakness in the part, with dragging pains and is very frequently accompanied by colicky sensations and dyspeptic derangements. The patient also, under these circumstances, is in a state of considerable danger, lest the rupture becomes strangulated by violent efforts, or injured and inflamed by blows. For these reasons, it is necessary not only to protect a rupture of this kind from external violence, but to endeavor to prevent its increase in size. This may best be done by letting the patient wear a truss with a large concave pad, which supports and protects it provided the rupture be not of too great a size for the application of such an instrument. If its magnitude be very considerable, it must be supported by means of a suspensory bandage. Mr. Bransby Cooper has recommended that an attempt should be made to convert the irreducible into a reducible hernia, by keeping the patient in bed for several weeks, on low diet, with the continued application of ice to the tumor; and if it contain much omentum, giving small doses of blue pill and tartar emetic, so as to promote the absorption of the fat. This plan, which appears to have answered well in some cases, certainly deserves a further trial.

The occurrence of *inflammation in an irreducible hernia* is a serious complication, and one that simulates strangulation very closely. When this complication occurs the part becomes swollen, hot, tender, and painful; there is not much tension in the tumor which is seldom increased beyond its usual magnitude; there is a good deal of pyrexia, and symptoms of peritonitis spreading from the vicinity of the inflamed rupture set in. In some cases there is vomiting, but it is not constant, and never feculent, occurring generally early in the disease, and consisting principally of the contents of the stomach, being apparently an effort of nature to get rid of an indigestible meal. If there is constipation, as usually happens in all cases of peritonitis, it is not complete, flatus occasionally passing per anum, together with a small quantity of fluid fæces. It is of importance in these cases to observe that the inflammation commences in the body of the sac, and extends into those parts of the abdomen that are contiguous to its neck; the stomach and intestinal derangements being secondary to this condition. The treatment of an irreducible hernia must be directed to the peritonitis which attends it; the application of leeches to the sac and its neck, the free administration of calomel and opium, the employment of enemata, with strict antiphlogistic regimen and rest, will usually speedily subdue all inflammatory action.

An irreducible hernia occasionally becomes obstructed, then constituting the condition termed *incarcerated hernia.* This condition principally occurs in old people, by the accumulation of flatus, or of undigested matters, such as cherry stones or mustard seeds, in an angle of the gut. In these cases there is constipation, with eructation, and perhaps occasional vomiting. There may be some degree of pain, weight, or uneasiness about the tumor, but there is no tension in it or its neck, and the symptoms altogether are of a chronic and subacute character. The treatment of such a case as this should consist in the administration of a good purgative injection; the compound colocynth enema is the best, thrown up as high as possible by means of a long tube. Ice may then be applied to the tumor for about half an hour, and then the taxis, as will immediately be described, may be used under chloroform. The ice may be omitted in those cases in which, on handling the tumor, gurgling can readily

be felt; but the taxis should always be used, as by it the incarcerated gut may be partially emptied of its contents; or if any additional protrusion should have happened to have slipped down, this may be returned. After these means have been employed, an active purgative, either of calomel or croton oil and colocynth should be administered, and if any inflammation ensue, this must be treated as already described.

STRANGULATED HERNIA.

A hernia is said to be *strangulated* when a portion of gut or omentum that is protruded is so tightly constricted that it cannot be returned into the abdomen; having its functions arrested, and if not relieved speedily, running into gangrene. This condition may occur at all periods of life, being met with in infants a few days old, and in centenarians. It commonly arises from a sudden violent effort by which a fresh portion of intestine is forcibly protruded into a previously existing hernia, which it distends to such a degree as to produce this strangulation. But though old herniæ are more subject to this condition than recent ones, it may occur at the very first formation of a hernial swelling, the gut becoming strangled as it is protruded. There are, therefore, two distinct kinds of strangulation. One which may be said to be of a passive kind, chiefly occurring in elderly people, the subjects of old and perhaps irreducible herniæ, which in consequence of some accidental circumstance become distended by the descent of a larger portion of intestine than usual, and this, undergoing constriction and compression at the neck of the sac, gradually becomes strangulated. The other kind of strangulation is most frequent in younger individuals; in it the symptoms are of a more active character, the bowel becoming protruded in consequence of violent exertion, and undergoing rapid strangulation, the tension of the parts not having been lessened by the previous long existence of an irreducible hernia.

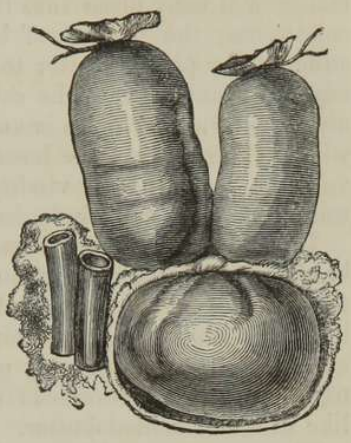
The mechanism of strangulation has been attributed either to a spasmodic action of the walls of the aperture through which the hernia protrudes, or else may be considered as dependent on changes taking place in the protruded parts, subsequent to and occasioned by their constriction by the tissues external to them. The strangulation cannot, I think, with justice, ever be regarded as of a spasmodic character, the aperture in the abdominal wall, through which the hernia escapes, being tendinous, or fibrous, and certainly not in any way contractile, though the action of the abdominal muscles may undoubtedly increase the tension of its sides; the continued and permanent character of this strangulation, when once it has taken place, would also discountenance this opinion; those forms of hernia, indeed, as the ventral, which occur in purely muscular structures, being very rarely strangulated, and when they are so, the constriction being generally occasioned by the formation of dense adventitious bands upon or within the sac, and not by any muscular agency.

Strangulation certainly appears in all cases to be the result of congestion of the protruded parts, induced by the constriction to which they are subjected; the mechanism being as follows: — A knuckle of intestine, or bit of omentum is suddenly protruded during an effort of some kind. This immediately becomes compressed by the sides of the narrow aperture through which it has escaped; the return of its venous blood is consequently interfered with, and swelling and œdema rapidly ensue, together with stagnation of the blood in it. If the constriction be excessively tight, the walls of the ring being very hard and sharp, the part that is so strangulated may be deprived of its vitality in the course of a few hours. If the strangulation be less severe, the congestion will run into inflammation, the changes characteristic of this condition speedily supervening. In proportion as the congestion augments, and the inflammation

comes on, the return of the protruded parts is necessarily rendered more difficult by the increase of their swelling.

The *stricture* is most commonly situated outside the neck of the sac in the tendinous or ligamentous structures surrounding it; not unfrequently in the altered and thickened subserous cellular tissue. In other cases again, and indeed with great frequency, it is met with in the neck of the sac itself (fig. 308), which is narrowed, elongated, and tubular, or constricted by bands that are incorporated with it. More rarely it exists in the body of the sac, which may have assumed an hour-glass shape. In some cases it would appear as if this particular shape were owing to an old hernia having been pushed down by a recent one above it. The stricture is sometimes, though by no means frequently met with inside the sac, consisting of bands of adhesions stretching across this, or of the indurated edge of an aperture of the omentum through which a portion of the gut has slipped.

Fig. 308.



The changes induced in the strangulated parts result from the pressure of the stricture and the consequent interference with the circulation through them. If the strangulation is acute, that portion of intestine which lies immediately under the stricture will be seen to be nipped or marked by a deep sulcus, which is occasioned partly by the pressure to which it has been subjected, and partly by the swelling up of the congested tissues beyond it. The changes that take place in the protruded intestine rapidly increase in proportion to the length of the continuance of the strangulation. The tightness of the stricture and the acuteness of the strangulation have, however, more to do with these changes than even the time that it has lasted. I have seen the bowel so tightly nipped that, though the strangulation had only existed eight hours when the operation was performed, the vitality was lost in the part constricted (fig. 307); and in other cases I have known the strangulation to have lasted for five or six days before the operation was performed, and yet the part recover itself.

The first change that takes place in the protruded parts in a case of strangulated hernia is their congestion; this rapidly runs on to inflammation, and speedily terminates in gangrene. The protruded bowel becomes, at first, of a claret, maroon, or purplish-brown color, sometimes ecchymosed on the surface, with thickening and stiffening of its coats, owing to effusion into their substance; some liquid is also usually poured out into its interior. In this stage, that of congestion, the omentum will also be found with its veins a good deal congested. When inflammation has set in, the bowel preserves the same color as in the congested condition, but usually becomes coated here and there with flakes of lymph, which give it a rough and villous look; the omentum has a somewhat rosy tinge, and there is usually a good deal of reddish fluid poured out into the sac. When gangrene occurs, the bowel loses its lustre and polish, becoming of an ashy grey, or dull black color, soft and somewhat lacerable, so that its coats readily separate from one another; the serous membrane especially peeling off. The omentum is dark purplish, or of a kind of dull yellowish-grey, and there is usually a considerable quantity of dark, turbid serum in the sac, the whole contents of which are extremely offensive. Most usually when gangrene occurs in a strangulated rupture, inflammation of the sac and its coverings takes place, accompanied, after a time, by a reddish-blue or congested appearance and some tenderness on pressure, and if the part is left unreduced, eventually emphysematous crackling. If the case is left without being relieved,

gangrene of the skin will at last take place, the sac giving way and the fæcal matters being discharged through the softened and disintegrated tissues. Under such circumstances as these, which, however, are very rarely met with at the present day, the patient usually eventually dies of low peritonitis by extension of the inflammation to the serous membrane. No effusion, however, of feculent matter will take place into the peritoneal cavity even under such unfavorable conditions; the portion of bowel immediately within the stricture becoming adherent by plastic matter to this on its internal surface, and thus the escape of any extravasation into the cavity of the abdomen being prevented. It does not always follow that there is any external evidence of the occurrence of gangrene within the sac; and the bowel is frequently nipped to such an extent as to prevent its regaining its vitality without any unusual condition being presented until the sac is actually laid open and the intestine examined.

In the more advanced cases of strangulated hernia, the peritoneum always becomes inflamed, usually to a considerable extent, the disease affecting a diffuse form, accompanied by the effusion of turbid serum, often of a very acrid and irritating character, and mixed with flakes of lymph, sometimes to such an extent as to give it a truly puriform appearance. This glutinous lymph mats together contiguous coils of intestine, often appearing to be smeared over them like so much melted butter.

The *symptoms* of strangulation are of two kinds: 1st, as they affect the tumor; and 2d, as they influence the constitution generally.

1st. The tumor, if the hernia be an old one, will be found increased in size, or it may appear for the first time when strangulated. It will generally be found to be hard, tense, and rounded, more particularly if it be an entrocele. When the hernia is in a great measure omental, it is, however, not unfrequently soft and doughy, though strangulated. It seldom increases in size after strangulation has occurred, as no fresh protrusion can take place below the stricture, but I have known it to be greatly augmented in bulk after the strangulation had existed for some hours, by the effusion of serum into the sac. If the hernia have previously been reducible, it can no longer be put back, and there is no impulse in it, or increase in its size on coughing, the stricture preventing the transmission of the shock to the contents of the tumor; and in this way, as pointed out by Mr. Luke, the situation of the constriction may sometimes be ascertained by observing at what point the impulse ceases.

2d. So soon as the strangulation has occurred, the patient becomes uneasy and restless. If the constriction be of an active character, he will be seized with acute pain in the part, which speedily extends to the contiguous portion of the abdomen, assuming the characters of peritoneal inflammation. The first thing that happens when intestine is strangulated, whether a large coil be constricted, or a small portion only of the diameter of the gut be nipped, is an arrest of the peristaltic movement of the part implicated, the occurrence of obstruction to the onward course of the intestinal contents, followed by constipation, vomiting, and colicky pains. The constipation is always complete, neither fæces nor flatus passing through; the bowels may sometimes act once after the strangulation has occurred from that portion which lies below the seat of constriction, but they cannot, of course, empty themselves thoroughly, or from above the strangled part. Vomiting usually sets in early, and is often of a very severe and continuous character, with much retching and straining; at first consisting of the contents of the stomach, with some bilious matters, but afterwards becoming feculent, or stercoraceous, owing to inverted peristaltic action extending as far down as the constricted part of the gut. These symptoms are attended by colicky and dragging pains about the navel. They are more severe in their character when the strangulation is acute and the hernia is intestinal, than when it is passive, and the rupture omental. They occur equally in the incomplete as in the complete forms of the disease; indeed, it not unfrequently happens

that the hernial tumor may be so small as to have escaped observation; the occurrence of the above symptoms being the first indication of the probable nature of the mischief. Hence, it is well always to examine for hernia when called to a patient suddenly seized with constipation, vomiting, and colicky pains, even if told that no tumor exists.

After the strangulation has existed for some time, the inflammation that occurs in the sac extends to the contiguous peritoneum, accompanied by the ordinary signs of peritonitis, such as tension of the abdominal muscles, tenderness, with lancinating pains about the abdomen, and tympanitis. The patient lies on his back with the knees drawn up, has a small, hard, quick, and perhaps intermittent pulse, a dry tongue, which speedily becomes brown, and a pale, anxious, and dragged countenance, with a good deal of heat of skin, and inflammatory fever. In some cases, this is of a sthenic type, but, in the majority of instances, especially in feeble subjects, it assumes the irritative form. When gangrene of the rupture takes place, hiccup usually comes on, with sudden cessation of pain in the tumor, an intermittent pulse, cold sweats, pallor, anxiety, rapid sinking of the vital powers, usually with slight delirium, and speedy death.

The symptoms just given are those that we usually meet with in strangulated hernia. They may, however, be modified in some important respects.

1st. There may be little or no tension in a strangulated hernia, the tumor continuing soft and lax; this is especially the case when the hernia contains omentum, and in congenital herniæ when strangulated. It may also occur in the case of double herniæ on the same side, in consequence of the outer sac being empty, or merely filled with serum, and the posterior one being protruded against this and strangulated; but its tension being masked by the lax state of the outer one.

2d. Vomiting sometimes does not take place from first to last, there being at most a little retching; at other times the patient vomits once or twice, and then there is no recurrence of this symptom so long as he remains quiet.

3d. Extensive peritonitis with copious effusion of a puriform liquid may occur without any pain, and with but little tenderness; the anxiety of countenance and sharpness of pulse being the only symptoms that lead to a suspicion of its existence.

4th. Death may result from exhaustion consequent on vomiting and peritonitis, without any sign of gangrene in the constricted portion of intestine.

Strangulated hernia requires to be diagnosed —

1st. *From an obstructed irreducible hernia.* In this there are no acute symptoms, and the rupture will generally be found to be a large one of old standing. It may become somewhat tense and swollen, but is not tender to the touch, and always presents a certain degree of impulse on coughing. There is no sign of peritonitis. There may be constipation, but there is no vomiting, or if there be any, it is simply of a mucous and bilious character, consisting of the contents of the stomach. The speedy restoration of the intestinal action, by the treatment already indicated as proper in these cases, will remove any doubt as to the nature of the affection.

2d. *From an inflamed irreducible hernia.* Here there is great tenderness and pain in the tumor, with pyrexia, and some general peritonitis, but there is no vomiting; or if the patient have vomited once or twice, he does not continue to do so with that degree of violence, or in the same quantity, as he would if the peritonitis were the result of strangulation. Then, again, the constipation is not absolute and entire, but flatus and liquid fæces will usually pass.

3d. *From general peritonitis conjoined with hernia,* the diagnosis is often extremely difficult, more especially if the hernia be an irreducible one. In these cases, however, it will be observed that the peritonitis may be most intense at a distance from the sac; that there will be little or no vomiting, or if there

be, that it is simply of mucus, and the contents of the stomach; and that the constipation is by no means obstinate or insurmountable by ordinary means.

4th. In the case of *double hernia*, one tumor may be strangulated and the other not, though irreducible. Under these circumstances it may at first be a little difficult to determine which one is the seat of constriction. This, however, may be ascertained, as in a case that was lately under my care at the Hospital, by observing greater tension and tenderness about the neck of the strangulated, than of the unconstricted one. Besides these various conditions of hernia, which may be confounded with strangulation, there are other tumors which may likewise be mistaken for this disease, but these we shall have to consider when speaking of the special forms of hernia.

The *treatment of strangulated hernia*, is one of the most important subjects in surgery The object sought to be accomplished is the removal of the constriction from the strangled hernial tumor. This is effected either by the reduction of its contents or the division of the stricture. The reduction of the hernia is effected by the employment of the *taxis*, by which is meant the various manual procedures employed in putting the rupture back. The taxis, when properly performed, is seldom attended by any serious consequences to the patient. I have never known it followed by death, and out of 293 cases of hernia reported by Mr. Luke, as having been reduced by the taxis in the London Hospital, none died. It is not unfrequently followed, however, by rather a sharp attack of peritonitis, which might probably, in some instances, prove fatal; in one instance I have seen it followed by very abundant hemorrhage from the bowel, probably owing to the rupture of some of the congested vessels of the strangled portion of the gut. In using the taxis, great care should in all cases be employed, and no undue force should ever be had recourse to. No good can ever be effected by violence, the resistance of the ring cannot be overcome by forcible pressure, and a vast deal of harm may be done by squeezing the tender and inflamed gut up against its edge, causing it to overlap, and thus to be bruised or even perhaps torn. The taxis should not be prolonged beyond half an hour; if properly employed for this time, the hernia, if reducible, will probably go back. If it be employed, as it is often very improperly, for a lengthened period, and by several surgeons in succession, the protruded part becomes ecchymosed, irritated, and disposed to inflammation, and the chances of recovery after a subsequent operation are much lessened. When the parts are much inflamed, the taxis should be employed with great caution; and if it have been fairly and fully used by another surgeon it is better not to repeat it. When gangrene has occured, it should never be employed, as the putting back of the mortified gut into the abdomen would be followed by extravasation of fæces and fatal peritonitis.

In using the taxis, it should be borne in mind that there are two obstacles to overcome; the resistance of the parts around the ring, and the bulk of the tumor. The first may be somewhat lessened by relaxing the abdominal muscles, and consequently diminishing the tension exercised upon the tendinous apertures and fasciæ of the groin. In order to effect this, the patient should be placed in a proper position, the body being bent forwards, the thigh adducted, and semi-flexed upon the abdomen; the surgeon may then, by employing steady pressure on the tumor, endeavor to squeeze out some of the flatus from the strangled portion of intestine, and thus to effect its reduction. In doing this, the neck of the sac should be steadied by the fingers of the left hand; whilst, with the right spread over the tumor, the surgeon endeavors to push it backwards, using a kind of kneading motion, and sometimes in the first instance drawing it slightly downwards, so as to disentangle it from the neck of the sac. The direction of the pressure is important; it should always be in the line of the descent of the tumor. These means may be employed as soon as the patient is seen by the surgeon, when, by steadily carrying on the taxis for a few

minutes, he will perhaps hear and feel a gurgling in the tumor, which will be followed by its immediate reduction. If the patient is thin, and the outline of the aperture through which the hernia escapes, tolerably defined, I have succeeded in reducing the protrusion, after failure of the taxis in the ordinary way, by passing the tip of my finger or the nail under the edge of the ring, and pulling this firmly and forcibly on one side so as to steady and at the same time dilate it, pressure being kept up on the tumor with the other hand. This manœuvre can be practised with more facility and success in femoral hernia, where the upper edge of the saphenous opening is sharply defined, but may also successfully be had recourse to in inguinal and umbilical protrusions; should, however, reduction not ensue, it will be desirable to have recourse at once to further means, the object of which is by relaxing the muscles and lessening the bulk of the tumor to enable the hernia to be reduced.

The means to be employed must be modified according to the condition of the strangulation, whether it be of the active or passive kind. If it be very acute, occurring in a young, robust, and otherwise healthy subject, the patient may have about twelve or sixteen ounces of blood taken away from the arm; he should then be put into a hot bath, where he may remain for twenty minutes or half an hour, or until he feels faint, and whilst in the bath in this condition the taxis should be employed. If it do not succeed, he should be taken out, wrapped up in blankets, and have chloroform administered. When fully under the influence of this agent, which is certainly the most efficient that we possess for relaxing muscular contraction, the taxis may be tried once again. Should it still fail, the operation should be immediately proceeded with.

No good can possibly come of delay in these cases, and repeated attempts at the taxis should be carefully avoided. If the hernia does not admit of reduction in the early stage of the strangulation, it will necessarily be much less likely to do so when the parts, by being squeezed and bruised by much manipulation, will have their congestive condition greatly increased. The frequent employment of the operation without opening the sac, of late years, very properly renders surgeons much less averse to early division of the stricture than was formerly the case.

When the strangulation is less acute, or occurs in a more aged or less robust subject, it is well to omit the bleeding, and to trust to the warm-bath and the chloroform.

When the strangulation is of a passive character, and occurs in feeble or elderly people, other measures may be adopted with the view of lessening the bulk of the tumor, which, rather than the tension of the parts, offers the chief obstacle to reduction in these cases. Under such circumstances, especially when the tumor is large, and not very tense, I think it is well to dispense with the hot-bath, which has sometimes a tendency to increase any congestion that may already exist in the hernia; I have in more than one case seen a strangulated rupture enlarge considerably after the employment of the bath. In such cases as these, more time may safely be spent in attempts at reduction than in very acutely strangulated herniæ. It is, I think, a useful practice to commence the treatment by the administration of a large enema, which, by emptying the lower bowel, will alter the relations of the abdominal contents, and may materially facilitate the reduction of the tumor. The best enema is one of gruel and castor-oil, with some spirits of turpentine added to it; it should be injected through a full-sized tube, and passed high up into the gut, and with a moderate degree of force. In administering it, care must be taken that no injury be done to the bowel. It would scarcely be necessary to give such a caution as this, were it not that I was summoned, some years ago, by two very excellent practitioners to see a woman with strangulated femoral hernia, to whom an enema of about two quarts of tepid water had been administered; and as this had not returned, and did not appear to have gone up the bowel, they suspected that it must have

passed out of the rectum into the surrounding cellular tissue. As the patient, however, did not seem to be suffering from this cause, and as the symptoms of strangulation were urgent, I operated on the hernia. Death suddenly occurred, apparently from exhaustion, in about eight hours, and on examining the body it was found that the rectum had been perforated, the fluid injected into the meso-rectum, separating the gut from the sacrum, and had thence extended into the general sub-peritoneal cellular tissue, which contained a quantity of the liquid; some of the water also appeared to have got into the peritoneal cavity.

In the large herniæ of old people in which there is a good deal of flatus, after the enema has been administered, a bladder of ice may be applied for three or four hours with excellent effect. Chloroform may then be given, and the taxis employed under its influence. Of late years, indeed, I have been in most cases in the habit of trusting almost solely to chloroform as a relaxing agent, and have often dispensed with the use of the warm-bath, and the other means just detailed. I put a patient with strangulated hernia at once under chloroform, and then try the taxis for a few minutes, not exceeding half an hour; if this fail, I then at once proceed to the operation without any further attempts at reduction, which are not only useless, but injurious, by bruising the protruded parts.

After the reduction of a strangulated hernia, constipation and retching, with nausea, may occasionally continue; and the tumor, if the hernia have been small and deep-seated (more particularly if femoral), may continue to be felt, though less tense than before; consisting simply of the sac thickened and inflamed, with serous fluid in it. Under these circumstances we must be careful not to operate. I have, on two or three occasions, seen an empty sac operated on, to the annoyance of the surgeon and danger of the patient. The mistake may be avoided by observing that the symptoms gradually lessen in severity by waiting, and that the tympanitis subsides, the abdomen becoming more supple.

The length of time that the congestive condition of the bowel will continue after a strangulated portion of intestine has been reduced is very considerable. In a case of strangulated femoral hernia which was some time ago under my care, reduction was effected, but strangulation recurring at the end of twelve days an operation became necessary; this was performed, and the patient died on the eighth day after it, or the twenty-first from the first strangulation. On examination, the small intestine was found congested in two distinct portions, each of which was about eight inches in length, and had several feet of healthy gut intervening. One of these congested portions lay opposite the wound, and was evidently the intestine that was last strangulated. The other was altogether away from the seat of operation, but was equally darkly congested, being almost of a black color, and was clearly that portion which had been constricted some time previously; and which, although twenty days had elapsed, had not as yet recovered itself.

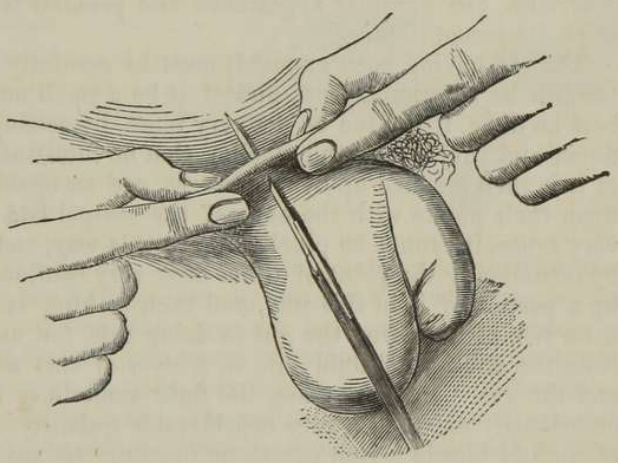
After the taxis has been fairly employed for a sufficient time, and has not succeeded in reducing the hernia, the operation must be proceeded with. It is impossible to lay down any definite rule as to the time that it is prudent to continue efforts at reduction, but it may be stated generally that after the different adjuvants of the taxis the surgeon may think it desirable to apply, have been fairly tried and have failed, the operation should be undertaken without further delay. There are few surgeons who will not at once acknowledge the truth of the remark of the late Mr. Hey of Leeds, — that he had often regretted performing this operation too late, but never having done it too early. It is true that cases are occasionally recorded, in which after four or five days of treatment the hernia has gone up; but how rare it is to meet with such cases in practice; and in all probability in delaying the operation in the hope of finding one such case, the lives of dozens of patients would be sacrificed. Mr. Luke has shown as the result of the experience at the London Hospital, that the ratio of mor-

tality increases greatly in proportion to the length of time that the strangulation is allowed to continue. Of 69 cases of strangulated hernia operated upon within the first 48 hours of strangulation, 12 died, or 1 in 5·7; whilst of 38 cases operated on after more than 48 hours had elapsed, 15 died, or 1 in 2·5. Indeed, one chief reason of the greater mortality from operations for hernia in hospital than in private practice, probably arises from the fact that much valuable time is frequently consumed before assistance is sought, or in fruitless efforts to reduce the swelling before the patient's admission. Not only is time lost in this way, but the bowel is often bruised and injuriously squeezed, so that inflammation already existing in it is considerably increased.

OPERATION FOR STRANGULATED HERNIA.

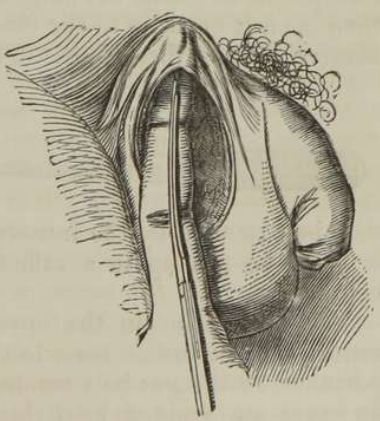
The operation for strangulated hernia may be performed in two ways; either by opening the sac, exposing its contents, and dividing the stricture wherever it is situated, *from within*; or, it may be done by dividing the stricture *outside*, without opening the sac. In either case the great object of the operation, the division of the stricture by the knife, is the same; but the mode in which it is effected is different. We shall first describe the operation in which the sac is opened —afterwards that in which it is not; and then briefly compare the two procedures.

Fig. 309.



Operation. The patient having been brought to the edge of the bed, or placed on a table of convenient height, the bladder should be emptied, and the parts that are the seat of operation shaved. An incision of sufficient length is then made over the neck of the sac; this may be best done by a fold of skin being pinched up, transfixed by pushing the scalpel across its base with the back of the instrument turned towards the hernia, and then cutting upwards (fig. 309); a linear incision is thus made which may be extended at either end if necessary; the dissection is then carried through the superficial fascia and fat with the scalpel and forceps. If any small artery spout freely, it had better be tied at once, lest the bleeding obstruct the view of the part in the subsequent steps of the operation. As the surgeon approaches the sac, more caution is required, more particularly if the sub-serous cellular tissue is dense, opaque and laminated. The surgeon must pinch this up with the forceps, make a small incision into it, introduce a director, and lay it open upon this, or on the finger (fig. 310). If it is thin and not opaque, so as to admit a view of the subjacent

Fig. 310.



parts, he may dissect it through with the unsupported hand. In this way he proceeds until the sac is reached, which is usually known by its rounded and tense appearance, its filamentous character, and by the arborescent arrangement of vessels upon its surface. In some cases the surgeon thinks that he has reached the sac, when in reality he has only got upon a deeper layer of condensed cellular tissue in close contact with it; here the absence of all appearance of vessels, the dull and opaque character of the tissue and its more solid feel, together with the absence of the peculiar tension that is characteristic of the sac, will enable him to recognize the real state of things. In other cases again it may happen that the sac is so thin, and the superficial structures so little condensed, that the surgeon lays it open in the earlier incisions before he thinks he has reached it. Under these circumstances a portion of the intestine protruding might be mistaken for the sac. This dangerous error may be avoided by observing the peculiar smooth and highly polished appearance presented by the dark and congested gut; the absence of arborescent vessels and the non-existence of any adhesions between its deeper portions and the tissues upon which it lies. If the sac is prematurely opened and omentum protrudes, the granular appearance and peculiar feel of this tissue will at once cause its recognition.

The sac having been exposed, must be carefully opened; this should be done towards its anterior aspect; and if it be a small one, at its lower part. It may best be done, if the sac be not very tense, by seizing a portion of it between the finger and thumb, and thus feeling that no intestine is included; a small portion of it is then pinched up by the forceps, and an opening is made into it by cutting upon their points with the edge of the scalpel laid horizontally. If the sac be very tense, it cannot be pinched up in this way, and then it may best be opened by introducing the point of a fine hook very cautiously into its substance, raising up a portion of it in this way, and then making an aperture into it. There is little risk of wounding the gut in doing this, for, as the tension of the sac arises from the effusion of fluid into it, a layer of this will be interposed between it and the gut. In these cases, the fluid sometimes squirts out in a full jet, and occasionally exists in a very considerable quantity. I have seen at least a pint of slightly bloody serum escape on opening the sac of an old strangulated inguinal hernia. Most frequently, however, there is not more than half an ounce to an ounce, and sometimes the quantity is considerably less than this. In some instances, scarcely any exists, and then it becomes necessary to proceed with extreme caution in opening the sac, as the gut, or omentum, is applied closely to its inner wall. In such cases as these the sac is not unfrequently sufficiently translucent to enable the surgeon to see its contents through it, and he should then open it opposite to the omentum or to any small mass of fat that he may observe shining through it. The opening once having been made into the sac,

Fig. 311.

may be extended by the introduction of a broad director (fig. 311), upon which it is to be slit up to a sufficient extent to admit of the examination of its contents.

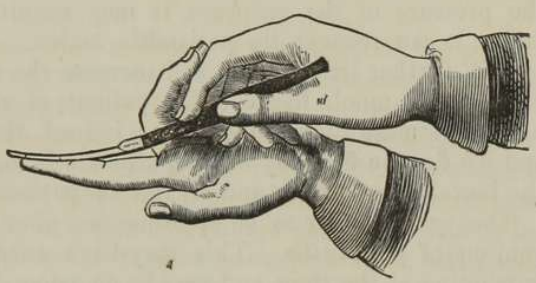
The next point in the operation is the division of the stricture; and this requires considerable care, lest injury be done to the neighboring parts of importance, or the gut be wounded. Vessels and structures in the vicinity of the stricture are avoided by dividing it in a proper direction, in accordance with ordinary anatomical considerations, which will be described when we come to speak of the special forms of rupture. All injury to the intestine is prevented by introducing the index-finger of the left hand up to the seat of stricture,

insinuating the finger-nail underneath it, and dividing the constriction by means of a hernia knife, having a very limited cutting edge (fig. 312). If a

Fig. 312.

director be used to guide the knife, the intestine will be in considerable danger, as the instrument may be slid under that portion of it which lies beneath the stricture, or the tense gut, curling over the side of the groove, may come in contact with the edge of the knife. These accidents are prevented by using the finger as a director, and slipping the hernia-knife (which should not have quite so long a probe-point as those usually made) along the palmar surface of the finger, upon its flat side: the finger serving to keep the bowel out of the way, and detecting any part that may be interposed between the edge of the knife and the stricture (fig. 313).

Fig. 313.



During the division of the stricture, the protruding portion of intestine must be protected from injury by the knife, either by the operator spreading his left hand over them, in such a way that they may not be touched by the edge of the instrument, or they may be protected by an attentive and careful assistant.

In some cases the stricture is so tight that it is at first almost impossible to get the edge of the nail underneath it. The surgeon will, however, generally succeed in doing so, by directing his assistant to draw down the coil of intestine, so as to loosen it, as it were, from underneath the stricture; he will then usually succeed in passing his finger up in the middle of the coil, where the mesentery lies. So soon as the blunt end of the hernia-knife has been got under the stricture, its sharp edge must be turned up, and the constriction divided in a proper direction, to a very limited extent, from the one-eighth to the quarter of an inch. The intestine and omentum must then be examined, and dealt with according to the condition in which they are found. If these structures are sufficiently healthy to admit of reduction, the intestine should first of all be replaced. This must be done by pushing it back with as much gentleness as possible, and chiefly by using the index fingers. When it has slipped up into the abdomen, the omentum must be returned in the same way. In reducing the hernial protrusion, after the sac has been laid open, care should be taken that the margins of this are firmly held down by means of a pair of forceps, lest it, together with its contents, be returned *en masse*, the stricture being undivided. After reduction, the surgeon should pass his finger up into the canal through which the hernia has descended, and see that all is clear. A suture or two should next be applied through the lips of the wound, with a few cross strips of plaster between them, a long pad of lint laid over it, and a spica bandage to retain it all in proper position. About the third or fourth day the sutures may be removed, and water-dressing applied. If inflammation or suppuration should set in, the part must be well poulticed, and care should be taken to leave the most dependent aperture free, as otherwise the pus formed in the external incisions may flow back through the inter-

nal aperture into the peritoneal cavity, and occasion fatal inflammation. Indeed I think it desirable that union of the lips of the wound after the operation for hernia should not take place by the first intention, as it not unfrequently happens, when this occurs, that the pus and other discharges not finding a ready outlet, may either be diffused between the muscular planes of the abdominal wall, occasioning sloughing and abscess, or either finding its way back into the peritoneal cavity, may excite inflammation of it — a result that I have more than once seen occur.

The patient should be kept quiet in bed, and, if there be no sign of peritonitis, have an opiate given him. The bowels will probably act in the course of the first twenty-four hours; should they not do so, a castor-oil and gruel enema may be thrown up. It is, I think, of very great importance not to administer any purgatives in these cases, and to take little heed of the bowels not acting, even for three or four days after the operation. If the mechanical obstacle have been removed, they will be sure to recover their proper action, though in consequence of the gut having been severely constricted and almost wounded by the pressure of the stricture, it may require to be left quiet for a few days before it can recover its peristaltic action. The administration of purgatives, by still further irritating it, will increase the risk of inflammation in it, and will probably do much harm. The patient, of course, must be kept upon the simplest and most unirritating diet; indeed, should only be allowed barley-water and ice for the first day or two, afterwards some beef-tea; but no solid food till the bowels have acted, and all risk of peritonitis has passed.

The great danger to be apprehended after operation for hernia is the supervention of *peritonitis*. This may have existed before the operation, may be impending at the time, and may be occasioned, or at all events greatly increased by the necessary wound of the peritoneum. Two distinct kinds of peritonitis commonly follow operations for hernia; one, the active or acute, the other, the passive or latent.

The *acute peritonitis* is the variety commonly met with in strong and robust people, otherwise healthy, who are the subjects of this operation. It presents the ordinary symptoms of acute idiopathic inflammation of the abdomen; there is tenderness of a diffused character, with lancinating pains. The patient lies on his back, with his knees drawn up, has an anxious countenance, a quick, hard pulse, a dry tongue, and much inflammatory fever; the respiration is principally thoracic, and tympanitis soon comes on. The bowels are usually constipated, though sometimes irritated. The *treatment* of this form of herniary peritonitis is best conducted upon ordinary antiphlogistic principles; the disease is a purely inflammatory one, and proper means must be taken to subdue it. This may be best done by free venesection and the application, perhaps repeated, of two or three dozen leeches to the abdomen; calomel and opium in pill must be administered every fourth or sixth hour, and the patient confined to barley-water and ice. As the inflammatory action is subdued, the constipation which is occasioned by it will be relieved without the necessity of administering any purgatives. The tympanitis may best be removed by turpentine enemata, and any lurking tenderness by the application of blisters.

Latent or passive peritonitis is a form of disease that appears to be of the diffused or erysipelatous character, chiefly occurring in old people, or in weakly subjects, and is especially apt to follow upon inflammation of the omentum and its consequent suppuration, or it may occur in consequence of the extension of diseased action from the cutaneous wound, and in other cases from the morbid condition induced by the strangulated gut. In hospital patients especially, in whom all disease is apt to assume a low character, this inflammation is peculiarly liable to occur. In some instances it sets in without the appearance of any marked local symptoms of inflammation, no pain or uneasiness in the abdomen; but two or three days after the operation the patient becomes depressed,

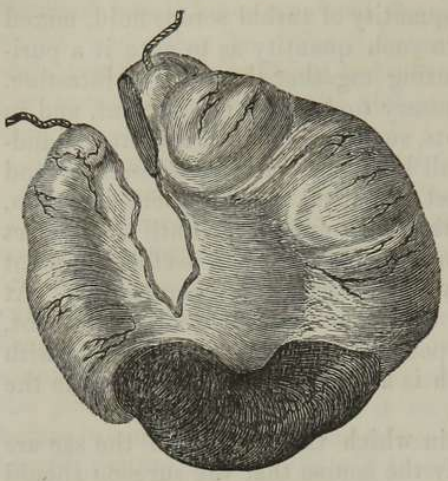
with a quick and weak pulse, an anxious countenance, a tumid and tympanitic abdomen, and rapid sinking of strength. In the majority of cases, however, some of the ordinary local signs of peritonitis are present. After death, the abdominal cavity will be found to contain a quantity of turbid serous fluid, mixed with flakes of lymph, in many instances in such quantity as to give it a puriform appearance, and not unfrequently matting together the coils of intestine. In the *treatment* of this affection it is necessary to support the patient, and in some instances even to administer stimulants, such as ammonia, the brandy-and-egg mixture, &c. Depleting measures of all kinds are quite inadmissible; and indeed, the remedy that offers most prospect of benefit to the patient is opium, in full doses, one grain being given every third or fourth hour until some effect is produced upon the constitution. Opium not only acts as a useful stimulant in these cases, but has a tendency to allay the increased vascular action. At the same time a blister to the abdomen, to be dressed with mercurial ointment, may be advantageously employed, and turpentine enemata administered, with the view of removing the tympanitis, which is a source of much distress to the patient.

Treatment of intestine.—The condition in which the contents of the sac are found in a case of hernia determines greatly the course that the surgeon should pursue after the division of the stricture. Most frequently the intestine is deeply congested, being of a reddish-purple, a claret, or chocolate color. This congested state must not be confounded with gangrene of the part, which might happen if the surgeon were to content himself simply with judging of its condition by the color. However dark this may be, the gut cannot be said to be gangrenous so long as it is polished and firm, free from putrescent odor, and without a greenish tinge. In cases in which there is much doubt as to whether its vitality continues or not, it has been proposed to scarify its surface lightly with the point of a lancet. If blood flows from the punctures, this may be taken as a proof of the continuance of the vitality of the part. Such a procedure as this, however, is certainly attended by some degree of danger, and can seldom be required.

When the intestine is merely congested, however deeply this may be, the rule is, that it should be returned into the cavity of the abdomen in the hope of its ultimately recovering itself; this it will generally do if it have not been too much handled after the sac has been opened; but in some cases it will slough a few days after it has been reduced, and the fæces being discharged through the wound, a feculent fistula will be formed, which may happen as late as the eighth or tenth day after the operation. In those cases, however, in which the intestine has been very tightly nipped by a sharp-edged stricture, so that a deep sulcus, or depression, is left upon it, it seldom, I think, recovers itself, whether the whole of the coil of gut has been thus affected, or the constriction has been limited to a small portion of the diameter of the intestine. It is remarkable how very quickly changes which are incompatible with life may ensue in a portion of gut that has been very tightly strangulated. I have known a coil of intestine, that had been but eight hours strangulated before the operation was performed, so tightly constricted as not to regain its vitality after its reduction (fig. 314). In such cases as these the patient usually dies of peritonitis in the course of a few days, without the bowels having acted, all peristaltic motion having necessarily been annihilated at the injured point. On examination after death, the constricted intestine will be found to present all the appearances of gangrene, being of a black or ashy-grey color, without having any flocculi or lymph deposited upon its surface, though these may be in abundance in the neighboring parts. From the very unfavorable result of those cases in which there has been very tight nipping of the protruded bowel, a very cautious prognosis should be given, and in reducing the gut after the division of the stricture, care should be taken not to push it far back into the abdomen, but to leave it near the inner

ring, so that in the event of its ultimately giving way, there may be less risk of feculent extravasation. In those cases in which the nipping has been very severe, the sulcus being distinctly marked, and the intestine excessively dark and congested, though not actually gangrenous, it would, I think, be better after dividing the stricture to leave the gut outside the ring rather than to return it; the reduction of intestine in this state being almost invariably followed by fatal peritonitis.

Fig. 314.



It is important to observe that although intestine which has been so severely nipped as this, may not be able to recover its vitality, and will fall into a state of gangrene after being reduced, yet that it does not at the time of its exposure present the characters of putrescence; there is no fetor, no green or pulpy appearance, or loss of polish or separation of peritoneum; it is simply of a dark purple or maroon color, and that it has been tightly nipped is evident by the sulcus upon it. There are no signs of gangrene, simply because sufficient time has not elapsed for putrefaction to set in. It is just as when a pile or nevus has been tied, though vitality is extinct in the part, which is swollen and purple, some time must elapse before signs of putresence manifest themselves; so it may be with a strictured gut which may have lost its vitality; and it should be treated as mortified intestine, though there be no sign of putridity about it.

When the intestine is actually gangrenous, the integuments covering the tumor will be infiltrated, brawny, and duskily congested, the structures immediately overlying the sac matted together; the sac will contain fetid dark-colored serum or pus, and the softened, lacerable, or pulpy look of the protruded part, its loss of lustre and peculiar greenish-black, or dark-grey color, will cause the nature of the mischief to be readily recognised. In the majority of cases there will be much constitutional depression, a clammy skin, tympanitic abdomen, and brown or black tongue, but in some instances I have known all these symptoms to be absent, and the condition of the patient to present no very unfavorable state. Some difference of opinion exists as to the proper line of practice to be adopted in such cases. Travers and Lawrence seem to think that the division of the stricture is unnecessary, or may even be injurious; whilst Dupuytren, A. Cooper, and Key (with whom I concur), advise that it should be done; that the stricture should be divided in the usual way, that a free incision should then be made into the protruded portion of bowel, which must be left unreduced, so as to allow the escape of fæces, and the wound left open, and covered by a poultice. In this way an artificial anus will necessarily be formed, through which the feculent matter finds exit. The gut in the vicinity of the stricture is retained *in situ* by masses of plastic matter, which prevent the peritoneal cavity being opened. If the intestine should already have given way before the operation is performed, the stricture must be divided and the part then left unreduced, care being taken to interfere as little as possible with any adhesions or connections lying inside the neck of the sac, though I fully agree with Aston Key, in thinking that the danger of disturbing them has been exaggerated.

When a small portion of the bowel only is gangrenous, the better plan is to return it into the cavity of the abdomen, without laying it open, but it should not be pushed any distance into this cavity; the pressure of the surrounding

parts will prevent extravasation. When the slough separates it will probably be discharged into the cavity of the intestine, and the aperture resulting will be closed by the adhesions that extend between its margin and the abdominal wall.

The *management of adhesions* varies according to the condition of the bowel and the nature and situation of the bands. As has just been remarked, if gangrene is present, especial care must be taken not to disturb any connections that have been formed about the neck of the sac, and which constitute the most effectual barrier against feculent extravasation. When the adhesions are recent, consisting merely of plastic matter, in whatever situation they exist, they may readily be broken down with the finger or the handle of the scalpel, and the parts then returned. When of old standing, and dense, they must be dealt with according to their connections. Most frequently these adhesions occur in the shape of thickened bands situated within and stretching across the neck of the sac. In other cases again, they may be found either as filamentous bands, or as broad attachments connecting the sac with its contents, and tying these, perhaps, together. When of a narrow and constricted form, and more particularly when seated in the neck of the sac, or stretching like bridles across its interior, they may readily be divided with a probe-pointed bistoury, or the hernia-knife. If consisting of broad attachments, they may be dissected away by a little careful manipulation from the parts in the inside of the sac; though if the adhesions be very extensive and of old standing, it may sometimes be more prudent to dissect away that portion of the sac which is in connection with them, or even to leave them untouched, and the adherent intestine or omentum unreduced, rather than to endeavor to separate them. They may, however, attach themselves in such situations that it becomes necessary to divide them; thus I have, in a case of congenital hernia, found it necessary to dissect away some very extensive and wide-spread adhesions that had formed between the omentum and the testicle, and which indeed had almost completely enveloped that organ.

Internal adhesions between the omentum and intestine or mesentery occasionally exist, consisting usually of pretty firm bands stretching across from one part to the other, sometimes connected with the inner wall of the sac, but in other cases confined to its contents; as these bands may constitute the real stricture, continuing to strangulate the gut after the division of the structures outside and in the neck of the sac, they must necessarily be divided. This operation requires great care, lest the neighboring intestine be wounded, and is best done by passing a director underneath, and cutting them through with a probe-pointed bistoury; or, if this cannot be done on account of their connections, they must be seized with the forceps and carefully dissected off the gut. In a case of large inguinal hernia, containing both gut and omentum, on which I operated some years ago, I found after dividing the stricture, and taking hold of the omentum in order to push back the intestine, that this could not be reduced. On searching for the cause of difficulty, and drawing the mass well down, I found high up, in the part corresponding to the neck of the sac, a narrow band, like a piece of whipcord, stretching across from the omentum to the mesentery and firmly tying down the gut. On dissecting this carefully through, the constricted portion of intestine subjacent to it sprung up to its full diameter, all constriction being removed, and was then very readily reduced.

Treatment of omentum.—If the omentum is small in quantity, healthy in character, though congested and apparently recently protruded, not having undergone those changes that occur in it when it has been a long time in a hernial sac, it should be reduced after the intestine has been put back. If, however, its mass be very large, or if it be hypertrophied, or otherwise altered in structure, at the same time that it is congested, I think the best surgeons

are agreed that it should not be returned into the abdominal cavity, as inflammation of it, *epiploitis*, will probably set in and terminate fatally with effusion into the peritoneal sac. So also, if the omentum is in large quantity, and has become inflamed in the sac, it should not be returned, as the inflammation in it is very apt to run on to a kind of sloughy condition of the whole mass. If gangrenous, it should certainly not be reduced. In all these cases of hypertrophied, inflamed, or gangrenous omentum, the best practice consists in cutting off the mass, as recommended by Sir A. Cooper and Lawrence. If it be left in the sac, inflammation or sloughing of it may occur, and the patient can derive no corresponding advantage to the danger he will consequently run. The excision of the mass may readily be performed by seizing and cutting it off at a level with the external ring. As the arteries of the stump, which are sometimes pretty numerous, are apt to bleed freely, they must be tied singly by fine ligatures, which should be left hanging out of the wound. There is often a tendency to the retraction of the stump of the omentum into the abdominal cavity, in which case the ligatures, dropping into the peritoneum, may become sources of great irritation; in order to prevent this, the better plan is, I think, to knot them together, and to fix their ends by a piece of plaster upon the forepart of the abdomen. Surgeons formerly were in the habit of including the constricted neck of the omentum in a tight ligature, cutting off the mass below this, and leaving the stump in the inguinal canal or ring. This practice has been generally abandoned, from dread of peritonitis being induced by the constriction of the ligature. It may, however, be safely followed in some instances, in those particularly in which the protruded mass is very much indurated, having a narrow neck. In some cases of this kind, occurring at the hospital, I have employed this practice with excellent effect. The quantity of omentum that is cut off varies considerably; the mass removed usually weighs from four to six ounces, but in some instances it may amount to a pound or more.

Sacs or apertures are occasionally formed in the omentum, in which a knuckle of intestine may have become enveloped, or by the margins of which it may be strangulated. These envelopes of omentum around the gut, which have been especially described by P. Hewett, may occur in all kinds of hernia, at least in the inguinal, the femoral, and the umbilical, and sometimes acquire a large size, completely shutting in the gut. It is of importance to bear their existence in mind, and in all cases to unravel the omentum before removing it, lest it contain a knuckle of intestine, which might be wounded in the operation.

Wounds of the intestine may accidentally occur at two periods of the operation, either by the surgeon cutting too freely down upon the sac, and opening this before he is aware of what he is about; or else, at the time of the division of the stricture, a portion of the gut which lies beneath it getting in the way of the edge of the knife, and being nicked by it. The first kind of accident can only happen from a certain degree of carelessness; but it is not always so easy to avoid wounding the gut when the stricture is so tight that the finger-nail cannot be slipped under it as a guide to the hernia-knife. In such cases as these, a very narrow director must be used; and this is a most dangerous instrument, as in passing it deeply out of sight under the tight stricture, a small portion of the gut may curl up over its side into the groove, and thus become notched by the knife as this is slid along it. This accident has happened to the best and most careful surgeons. Lawrence relates two cases that occurred to him, and Sir A. Cooper, Cloquet, Jobert, and Liston have all met with it. It may be known to have occurred by the bubbling up of a small quantity of flatus and liquid fæces from the bottom of the incision. The treatment of a wound of the gut must depend upon its size. When very small, rather resembling a puncture than a cut, the practice recommended by Sir A. Cooper should be adopted, viz., to seize the margins of the incision with a pair of forceps, and to tie a fine silk thread tightly round them, the ends of which should then be

cut off, and the gut returned into the abdominal cavity. Such a proceeding as this does not appear to give rise to much, if to any increase of danger. In a case that occurred to me at the Hospital, in which, owing to the excessive tightness of the stricture, a very narrow director could only be got under it, the gut immediately above it was notched and opened by a kind of punctured wound; this was tied up in the way mentioned, and after the death of the patient, which took place on the fourth day after the operation, from gangrene of the strangulated portion of bowel, the silk ligature was found to be completely enveloped in a plug of plastic matter. If the wound be of larger size, it must be closed by the glover's stitch.

Wound of one of the arteries in the neighborhood of the sac may occur during the division of the stricture, either in consequence of some anomaly in the distribution of the vessel, or from the surgeon dividing the parts in a wrong direction. This accident usually happens to the epigastric or obturator arteries, and Lawrence has collected 14 recorded cases in which it has occurred: the result in these has been very various. In some the patients have died; in others, after much loss of blood, and consequent faintness, the bleeding ceased spontaneously. The proper treatment would certainly consist in cutting down upon and securing the bleeding vessel. In the event of the surgeon operating on a case of hernia, without having been able previously to satisfy himself as to its precise character; or if from any cause in dividing the stricture he has reason to dread the proximity of an artery, he may safely and readily divide the constriction with a knife that would not easily cut an artery, and he will find, if he blunt the edge of his hernia-knife, by drawing it over the back of the scalpel, that it will still be keen enough to relieve the strangulation, whilst it would push before it any artery that might happen to be in the way.

Sloughing of the sac is of rare occurrence, and when it happens is commonly attended by fatal results; it is not, however, necessarily so. It has twice happened in my practice, and in both cases the patient recovered. In an old woman on whom I recently operated for femoral hernia of very large size, the sac sloughed away, exposing nearly the whole of Scarpa's triangle with almost as much distinctness as if it had been dissected; but although in much danger for a time from an acute attack of peritonitis, she ultimately recovered.

Artificial anus and fæcal fistula.—When an aperture exists in the bowel by which the whole of the intestinal contents escape externally, the disease is said to be an *artificial anus.* When but a small portion so escapes, the greater part finding its way out through the anus, a *fæcal fistula* is said to exist. The quantity of feculent discharge necessarily depends upon the extent of the destruction of the intestinal coats, and its character, on the part of the gut that is injured. The escape takes place involuntarily, and usually continuously. This condition may occur in several ways. Thus, the gut may be accidentally wounded during the operation, and the fæces afterwards continue to be discharged through the aperture so made; or it may have been gangrenous, and have given way into the sac before the operation; or the surgeon may have intentionally laid open a gangrenous portion of intestine, so as to facilitate the escape of the fæces. In some cases in which the bowel has been severely nipped, and is dark and congested, though it have not fallen into a state of gangrene, it may not be able to recover itself after its return into the abdominal cavity, but will give way in the course of three, four, six, or even ten days after the operation. In these cases, a small quantity of feculant matter is first observed in the dressings, and gradually a greater discharge appears, until at last the fistulous opening is completely established. In such cases, it is of importance to observe, that although the bowel gives way within the peritoneal cavity, the fæces do not become extravasated into this, but escape externally. This important circumstance is owing to the fact of the portion of the bowel that is nipped losing its peristaltic action, and consequently remaining where it

is put back; the parts in the neighborhood inflaming, throwing out lymph, and becoming consolidated to each other and to the parietal peritoneum, so as to include the gangrenous portion of the gut, and completely to circumscribe it. It is consequently of great importance, in such cases as these, not in any way to disturb the adhesions that have formed between the sides of the aperture in the gut and the neck of the sac.

The pathology of *artificial anus* is commonly as follows; — The edges of the aperture in the gut are glued by plastic matter to the abdominal wall, and whether the whole or a portion only of the calibre of the intestine is destroyed, the aperture of the upper and lower end, though at first lying almost in a continuous line, soon come to unite at a more or less acute angle. These are at first similar in size, and present no material differences in shape or appearance; as the disease becomes more chronic, they gradually alter in their characters, the lower aperture being no longer used for the transmission of fæces, gradually becoming narrower (fig. 316, *b*), until at last it may be almost completely obliterated, whilst the upper portion of intestine becomes dilated (316, *a*), in consequence of there being usually some slight obstruction to the outward passage of the fæces. The mesenteric portion, opposite the aperture, becomes drawn out into a kind of prolongation or spur, the full importance of which was first pointed out by Dupuytren. This spur-like process projects between the two apertures, and being deflected by the passage of the fæces, has at last a tendency to act as a kind of valve, and thus to occlude the orifice into the lower portion of the gut. The integuments in the neighborhood of such an aperture as this usually become irritated, inflamed, and excoriated, from the constant passage of the fæces over them. In some cases, the mucous membrane lining the edges becomes everted, and pouting; and, in others, a true prolapse takes place, large portions of the membrane protruding. An artificial anus fully formed in this way never undergoes spontaneous cure. Besides this, which is the ordinary form of artificial anus, we must, I think, recognize at least two other varieties, both of which I have met in practice. In one of these the angle formed by the gut is adherent to the upper extremity of the sac which has been returned, and thus lying at some distance from the surface, the fæcal matter traverses a long canal before it reaches the external aperture. In the other variety the angle of the gut is fixed at a higher point within the abdomen, and the fæces find their way out through a channel bounded by agglutinated coils of intestine and layers of lymph. In both of these forms there is a considerable distance between the external opening and the aperture in the gut. Thus, then, there are three forms of artificial anus, differing from one another according to the situation of the angle of the gut in relation to the external opening, and to its connections.

When a *fæcal fistula* has formed, the condition of parts is somewhat different. In these cases, the aperture in the intestine consists of merely a small perforation in its coats, unattended by any considerable loss of substance, through which a quantity of thin fluid and feculent matter exudes, giving rise to a good deal of irritation of neighboring structures. In some cases, there are several apertures communicating with the gut, and extending through the skin. Fistulous openings of this kind not unfrequently undergo spontaneous cure after existing for a few weeks or months.

Treatment of artificial anus.—As the existence of an artificial anus, by interfering with nutrition, commonly gives rise to considerable emaciation, it becomes necessary to support the patient's strength, by a sufficient quantity of good and nourishing food; this is of greater consequence the higher the fistula is, as the interference with the earlier stages of the digestive process, and the loss of nutritive material by the discharge of the chyme, is proportionately great. If the aperture be merely of a fistulous kind, the pressure of a pad, to prevent the escape of feculent matter, may enable a spontaneous closure of it to take place.

Spontaneous cure will occasionally take place, even though a perfect artificial anus exist. In a recent case under my care at the hospital, a whole knuckle of intestine was gangrenous, and sloughed away, leaving an artificial anus, which discharged the greater part of intestinal contents, but gradually contracted and closed without any local application or treatment beyond attention to cleanliness. If the aperture become a permanent artificial anus, surgical means must, if possible, be adopted in order to effect a cure. In accomplishing this, two important indications have to be fulfilled: the first is to diminish or destroy the projecting valvular or spur-like process, and thus to re-establish the continuity of the canal; and after this has been done, the external wound may be closed, by paring its edges, and bringing them together with harelip pins.

The first object is best accomplished by Dupuytren's *enterotome* (fig. 315); this consists of an instrument something like a pair of scissors, with blunt but

Fig. 315.

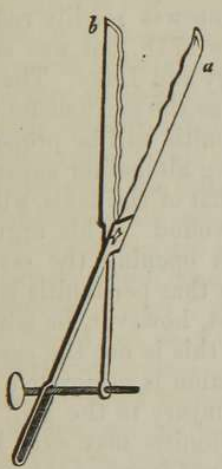
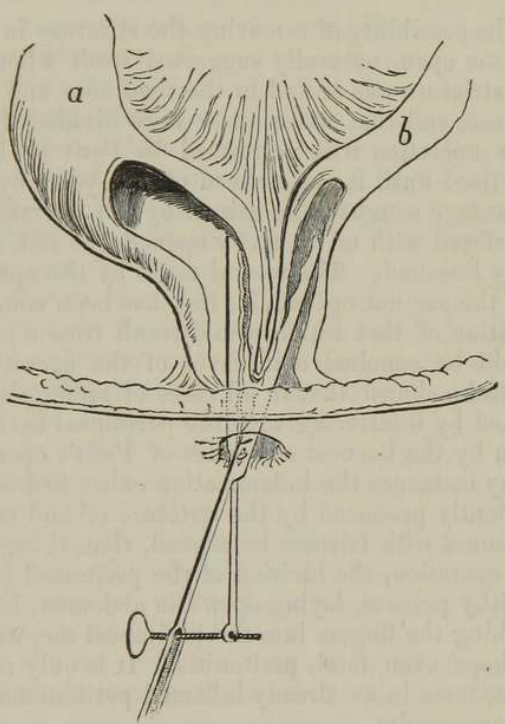


Fig. 316.



serrated blades, which may be brought together by acting upon a screw that traverses its handle. One blade of the instrument (*a*) is passed into the upper, the other (*b*) into the lower portion of intestine, they are then approximated slowly and fixed by means of the screw in such a way as to compress on either side the spur-like process (fig. 316). Very gradually, day by day, this screw is tightened so as to induce sloughing of this projection, and cohesion of its serous surfaces. As this action goes on, the irritation caused by the instrument will occasion plastic matter to be thrown out in the angle formed by the intestine, so that the peritoneum and mesentery become consolidated, and all opening into the peritoneal cavity avoided. Should the spur-like process be accidentally cut through before the lymph is thrown out in sufficient quantity, the peritoneum would be opened, and death probably ensue; hence the necessity for caution in this procedure. So soon as the blades of the instrument have come into contact, and the spur-like process has consequently sloughed away, the great obstacle to the closure of the artificial anus will be removed, and the continuity of the

canal being thus re-established, its lips may be pared and brought together by harelip pins and sutures.

[The late Dr. Physick devised and executed an operation by which he effected the destruction of the *eperon* or spur, and the re-establishment of the continuity of the intestinal canal, more easily than by the employment of the cumbersome and inconvenient *enterotome* of Dupuytren. He passed a curved needle armed with a ligature completely through the spur-like ridge, the needle entering through the orifice of one gut and emerging by the other. The extremities of the ligature being then loosely tied, in order to approximate the peritoneal surfaces, were fastened at the external opening; and the thread was allowed to remain thus for several days, until by its action as a seton, sufficient effusion of plasma had taken place to effect the consolidation desired. The ridge of gut was then divided by a bistoury.]

OPERATION FOR HERNIA WITHOUT OPENING THE SAC.

The possibility of removing the stricture in strangulated hernia without laying the sac open, naturally suggested itself when it was known that in many cases the stricture was seated in the tendinous and cellular tissues outside the neck of the sac, and that when these were divided the protrusion was readily reduced. This operation was performed by Petit as long ago as 1718, but was seldom practised until it was revived of late years by Aston Key and Luke. The great advantage sought to be gained by this operation is, that as the peritoneum is not interfered with or its cavity opened, the risk from peritonitis will be proportionately lessened. The wound made by the operation being altogether superficial, and the sac not opened, its risk has been compared to that of the taxis, with the addition of that which would result from a superficial wound. This argument would be conclusive in favor of the operation without opening the sac, if it could be shown that in all cases of strangulated hernia that peritonitis is occasioned by interfering with the peritoneal cavity; it must, however, be admitted even by the keenest advocates of Petit's operation that this is not the case. In many instances the inflammation exists before any operation is performed, being evidently produced by the stricture of and consequent injury to the gut. But it cannot with fairness be argued, that though the peritonitis may exist before the operation, the incision of the peritoneal cavity does not increase it; even in healthy persons, laying open the abdomen, handling the gut and omentum, and pushing the fingers into the peritoneal sac, would always be followed by intense, perhaps even fatal, peritonitis. It is only reasonable to believe that the same procedures in an already inflamed peritoneum would be followed by equally disastrous results.

That the opening made into the cavity of the abdomen in reality adds to the frequency of the peritonitis, cannot I think be doubted by any practitioner. It not unfrequently happens in strangulated hernia, that no sign of peritoneal inflammation sets in until two or three days after the operation is performed, and then occurs evidently as the result of this procedure. That the fatality of the peritonitis, even if existing before any operation be practised, must be greatly increased by interference with the serous sac, is evident from the fact that has been already mentioned that death very rarely occurs (not more than once in many hundred cases) after the reduction of a strangulated hernia by the taxis. Fully admitting, therefore, that in many cases the peritonitis exists before the operation, and is occasioned by causes independent of it; it is I think impossible to deny that the inflammation is frequently directly occasioned by opening the peritoneal cavity, and handling the viscera, and that when already existing, its fatality must be greatly increased by this procedure. In fact there are two causes for peritonitis in cases of operated strangulated hernia—viz., the constriction of the stricture, and the wound of the peritoneum. That peri-

tonitis which arises from the pressure of the stricture is equally liable to happen, whether Petit's operation or that by opening the sac is practised, and often precedes the operation; whilst the peritonitis which arises from wound of the serous membrane does not occur in Petit's operation, but is necessarily confined to that in which the sac is opened.

There are, however, two objections that may be urged against Petit's operation with more justice than that it does not tend to prevent the occurrence of peritonitis. The first is, that if the intestine be not seen, it may sometimes be returned in a gangrenous condition; and the second, that the gut may possibly be returned still strangled by bands of adhesion, or by inclusion in an omental aperture. With regard to the first objection, it may be stated, that if the intestine is in a gangrenous state there will usually be some evidence of this condition, either in the change that has taken place in the general symptoms of the patient, or in the condition of the sac and its coverings, which will enable the surgeon to guess at the condition of the enclosed parts, and would of course induce him to expose them fully and examine them thoroughly. This objection, however, cannot apply to those cases in which the strangulation has only existed for a time that would be insufficient to allow of the occurrence of gangrene, and does not therefore apply to the performance of Petit's operation in recent cases of strangulation. With regard to the occurrence of internal strangulation, it is excessively rare, and when it does occur it still more rarely happens, whether the strangulation is affected by bands of adhesion, or by an aperture in the omentum, that the parts can be returned without opening the sac, adhesions usually existing also between this structure and its contents. But the best answer to the objections against the operation without opening the sac, are the results that have followed this practice. Mr. Luke, who has had great experience on this subject, states that he has operated in 84 cases of hernia. In 25 of these the sac was opened; in 59 the sac remained unopened. Of the 25 in which it was opened, 8 died, whilst of the 59 in which Petit's operation was performed, only 7 died. If to Mr. Luke's cases we add those reported by Mr. N. Ward, we shall find 36 deaths in 153 cases of Petit's operation. That the ordinary operation indeed of opening the sac is an exceedingly fatal one, is well known to all hospital surgeons, and is fully proved by surgical statistics. Of 77 operations for hernia, reported by Sir A. Cooper, 36 proved fatal; and of 545 cases recorded in the journals, and collected by Dr. Turner, 260 are reported to have died. The result, therefore, of Mr. Luke's operations is most favorable, when contrasted with those in which the sac was opened.

The operation, without opening the sac, may be practised in all forms of hernia, but is much more readily done in some varieties of the disease than in others. It is especially applicable in cases of femoral hernia, in which the stricture is commonly outside the sac, as will be mentioned when speaking of that form of the disease. Of 31 cases of femoral hernia operated on by Mr. Luke, the sac only required to be opened in 7. In inguinal hernia it is not so easy to perform Petit's operation; indeed, in the majority of cases the surgeon will fail to remove the stricture in this way. This is owing to the constriction being usually seated in the neck of the sac, and is especially observable in congenital hernia. Of 20 inguinal herniæ operated on by Mr. Luke, the sac required to be opened in 13 instances.

For the various reasons that have been mentioned, I am decidedly of opinion that this operation should always be attempted in preference to the ordinary one of opening the sac, in those cases in which the hernia has not been long strangulated, presents no sign of the occurrence of gangrene in it, and more especially when it is femoral or umbilical. Even if the surgeon fail in completing Petit's operation, in consequence of the incorporation of the stricture in the neck of the sac, or the constriction of this part, no harm can have resulted; for the sac, after being exposed, may at any time be opened in the

ordinary way, and the operation completed by dividing the stricture from within.

When the hernia is of large size and irreducible, it is of especial importance to avoid opening the sac. If this be done, the contents will inflame, and fatal peritonitis commonly ensues. In these cases, as Mr. Luke has pointed out, it rarely happens that the adherent parts are seriously strangulated, but the whole mischief seems to be occasioned and to be received by the new protrusion that has taken place, and gives rise to the tension; and if this can be liberated and reduced, the surgeon has done all that need be accomplished. The evidence of the reduction of the recent protrusion, although the old adherent and irreducible hernia be left, is usually sufficiently obvious, the portion of gut returning with a slip and a gurgle, with considerable diminution in the general tension of the tumor.

With regard to the mode of performing Petit's operation, little need be said here, as it is precisely identical with the steps of the other operation up to the period of the exposure of the sac, except that, when it is not intended to open this, the incisions should be carried more directly over its neck. The stricture, if situated outside the sac, will then be found either in some of the tendinous structures surrounding it, or else in the subserous cellular tissue lying upon it. After the division of the constricting bands in this situation, by means of a probe-pointed knife carried underneath them, or by dissecting down upon them, an attempt at the taxis may be made by compressing the tumor in the usual way, at the same time that its neck is steadied by the fingers of the left hand. If the contents can be reduced, the incision in the superficial structures is brought together by a few strips of plaster, over which a pad and bandage may be applied. Should peritonitis come on, as the result of the strangulation, it must be treated in the usual way. If, after the surgeon has fairly divided all the structures outside the sac, he finds still that the return of the hernia is prevented by some constriction in its neck, it will be necessary to lay this open and divide the constriction in the usual way.

REDUCTION OF THE HERNIA IN MASS.

The reduction of the hernia in mass consists in the return of the sac and its contents into the abdomen, still in a state of strangulation. When it is said that the parts are returned into the abdomen, it must not be understood that they are pushed back into its cavity, but that the external protrusion is caused to disappear by being pushed into the subserous cellular tissue, behind and underneath the parietal peritoneum between it and the abdominal muscles. This remarkable accident, which was first described by the French surgeons of the last century, received little notice from practitioners in this country, until attention was drawn to it by Mr. Luke.

Reduction in mass has only been observed in cases of inguinal hernia, and has chiefly occurred from the patient's own efforts in reducing a strangulated rupture. It is a remarkable fact, that in most of the instances in which it has occurred, only a very slight degree of force appears to have been employed in the reduction of the tumor, and the accident would seem to have resulted from the adhesions between the sac and the neighboring parts being much weaker than natural, so that a moderate degree of force caused the whole to slip through the canal. It may, however, occur from the surgeon's efforts, if these are too forcible or long continued.

The *symptoms* indicative of this accident are constitutional and local. The constitutional symptoms consist in a continuance of those that are indicative of the existence of strangulation, notwithstanding the disappearance of the tumor. The vomiting and constipation persisting, the patient speedily becomes much

depressed in strength, being seized with hiccup and prostration of all vital power; signs of gangrene then evince themselves within the sac.

An examination of the parts of hernia will usually enable the surgeon to recognize the nature of the accident; he will ascertain that a tumor had previously existed, and will learn, from a description of its general characters and the symptoms occasioned by it, that it was in all probability a strangulated rupture. He will then find, on examining the part, that there is a total absence of all that fulness which is occasioned by the presence of the sac, even after its contents only have been reduced; the sac, in such cases, always giving rise to a feeling of fulness and roundness in the part. He will, on the contrary, find that the abdominal ring is peculiarly and very distinctly opened; it is much larger than usual, and somewhat rounded. On pushing the finger into the canal, this will be felt quite empty, but in some cases on deep pressure with the finger, especially when the patient stands up or coughs, a rounded tumor may be indistinctly felt behind the ordinary seat of the hernia. In many cases, however, the most careful manual examination will fail to detect any prominence of this kind.

If, after careful examination of such a case as this, in which the symptoms of strangulation continue, the surgeon learns by the previous history that a tumor has existed, that it has suddenly gone up, and, further, if he finds that the seat of the supposed hernia presents the negative evidence that has just been described, it will then be necessary for him to push his inquiries a step further by an exploratory incision. Such an incision as this may first be used as a simple means of diagnosis, and, as it does not penetrate the peritoneal cavity, there is no danger attending it; and if the hernia be found, it will serve the purpose of the ordinary incision required in the operation, and may be used for the relief of the strangulation. The first incision should be made so as to expose the abdominal ring; if this be found peculiarly round and open, it would increase the probability of the existence of the condition sought for. The inguinal canal must next be laid open, and the parts contained within it carefully examined. If no appearance of hernial sac is found, but the cord distinctly and clearly seen, still further presumptive evidence will be afforded of the reduction having been effected in mass; for if the hernia have been put back in the usual way, the sac will necessarily be left in the canal, and will preserve its usual relations to the cord. This supposition will be strengthened almost to a certainty if it be found that the "condensed cellular capsule immediately investing the sac," as it is termed by Mr. Luke — in other words, the condensed and laminated subserous cellular tissue — has been left in the canal. An opening made into this will, as that surgeon observes, allow the finger to be brought into contact with the hernial tumor itself. Should, however, this condensed cellular tissue not be found, it must not be concluded that no hernia is present, inasmuch as this investment may have been accidentally absent. The finger should then be passed into the internal ring, which will probably be found open, and being carried from side to side, the tumor, if present, will be detected lying external to the peritoneum, behind the abdominal wall. When found, it must be brought down into the canal by enlarging the ring; it must then be opened, its contents examined, and the stricture in its neck divided. The intestine that has been so strangled must be dealt with in accordance with the rules already laid down. If the tumor cannot be readily brought down so as to admit of an examination of it and its contents, the patient should be desired to make some propulsive efforts, so as to cause it to protrude. If it still do not come down, it must be opened, and the stricture cautiously divided within the abdomen with a sheathed bistoury.

Hydrocele of the hernial sac is a rare condition, the pathology of which has already been adverted to. In the treatment, two lines of practice are open, the palliative and curative. The first consists in merely tapping, and thus

withdrawing the fluid, and the other in freely laying open the lower portion of the sac, and endeavoring to secure its closure by granulation. This operation, which, however, is not devoid of danger, has been performed with success by Pott and others.

INGUINAL HERNIA.

By inguinal hernia is meant that protrusion which occupies the whole or a portion of the inguinal canal, and when fully formed passes out of the external abdominal ring into the scrotum. Many varieties of this hernia are recognized by surgeons. Thus it is said to be *complete* when it passes out of the external ring; *incomplete* or *interstitial*, so long as it is contained within the canal; *oblique*, when it occupies the whole course of the canal; *direct*, when it passes through a limited extent of it; *congenital*, when it lies in the sac of the tunica vaginalis; and *encysted* or *infantile*, when it lies behind this. Inguinal herniæ constitute the commonest species of rupture, and would be much more frequent than they are, were it not for the obliquity of the canal, and the manner in which its sides are applied to one another, and closely overlap the spermatic cord. They occur with most readiness in those cases in which the canal is short and the apertures wide. Although these herniæ are commonly incomplete in their early stages, it is seldom that they come under the observation of the surgeon, until the protrusion has passed beyond the external abdominal ring.

The *oblique* inguinal hernia, often called *external*, on account of its relation to the epigastric artery, passes through the whole length of the canal, from one ring to the other; and usually protrudes through the external one, constituting one of the forms of *scrotal* hernia. As it passes along the canal, it necessarily receives the same investments that the spermatic cord does, although these are often greatly modified in character by being elongated, hypertrophied, and otherwise altered in appearance. If we regard the inguinal canal as consisting of a series of invaginations of the different layers of the abdominal parietes, the outermost being the skin, and the innermost the fascia transversalis, with the peritoneum applied to this, it is easy to understand how the hernia in its descent has these prolongations drawn over it, thus becoming successively invested with the same coverings as the spermatic cord. Thus it first pushes before it that portion of the peritoneum which lies in a fossa, just external to the epigastric vessels; it next receives an investment from the fascia transversalis, which often becomes thickened and laminated, constituting the *fascia propria* of the sac; as it passes under the internal oblique, it receives some of the fibres of this muscle, in the shape of the cremasteric fascia, and lastly, when it reaches the external abdominal ring, which it greatly distends and renders round and open, it becomes covered by the inter-columnar fascia, receiving also a partial investment around its neck from some of the expanded and thickened fibrous bands that lie near the ring, and which are always most marked upon its outer side.

The relations of the spermatic cord and testes, and of the epigastric artery to an inguinal hernia are necessarily of great importance. The spermatic cord will almost invariably be found to be situated behind, or rather underneath the oblique inguinal hernia, and the testis will be found to lie at its lower and back part, where it may always be distinctly felt. In some cases the elements of the spermatic cord become separated, the vas deferens lying on one side, and the spermatic vessels on the other. In other rare cases again, an instance of which there is in a preparation in the University College Museum, the hernia lies behind the cord, and has the testis in front. In other cases again, it may happen, as was observed during an operation in which I assisted my friend, the late Mr. Morton, that the elements of the cord are all separately spread out on the forepart of the hernial tumor.

The epigastric artery has the same relations to the oblique inguinal hernia that it has to the spermatic cord, lying to the inner side of and behind its neck.

The pressure of large and old inguinal herniæ has, however, a tendency to modify somewhat the relations of this vessel. By distending the rings, and dragging the posterior wall of the canal downwards and inwards, they shorten the canal, and cause a great deflection of the artery from its natural course, which is changed from an oblique direction to being curved downwards and inwards, under the outer edge of the rectus muscle.

The *direct* inguinal hernia does not pass out like the oblique through the internal abdominal ring, but pushes forwards through a triangular space, which is bounded by the epigastric artery on the outer side, the edge of the rectus on the inner, and the crural arch at its base; through this the hernial tumor protrudes, pushing before it, or rupturing the posterior wall of the inguinal canal. The coverings that this form of hernia receives, vary according to the length of the canal that it traverses, and the portion of the posterior wall through which it protrudes. In fact, there are at least two distinct forms of direct inguinal hernia, which differ according as they are situated above or below the obliterated remains of the umbilical artery. One, the most common variety, is situated below the cord-like remains of this vessel, between it and the outer edge of the rectus. The other, which is of less frequent occurrence, is situated above this vessel, between it and the epigastric artery. In that form of direct inguinal hernia, which lies below the umbilical artery, the protrusion takes place through that part of the posterior wall of the inguinal canal which is situated almost behind and opposite to the external ring. In this situation, the investments successively received by the hernia, are, first, the peritoneum and the fascia transversalis; it then comes in contact with the conjoined tendons of the internal oblique and transversalis muscles, which it may either rupture or push before it, thinned out and expanded. Most frequently these are ruptured, constituting a partial investment to the protrusion, which is most evident on the innermost part of the sac, that which is nearest the mesial line. As the hernia passes through the external abdominal ring, it receives from it the inter-columnar fascia and fibres, and lastly is invested by the common fascia and integuments. In that form of direct inguinal hernia which lies above the umbilical artery, but which is of rare occurrence, the protrusion may pass under the lower edge of the transversalis muscle, and then receives a partial investment of cremasteric fascia, especially on its iliac side, as it comes into relation with the internal oblique. This form of direct inguinal hernia, therefore, receives very nearly the same covering that the oblique does, though its investment by the cremaster is not so perfect. It does not come into relation with the conjoined tendons.

In the direct inguinal hernia, the spermatic cord lies to the outer side of the sac (fig. 318), and its elements are never separated from one another, as occasionally happens in the oblique. The epigastric artery also is on the outer side, but usually arches very distinctly over the neck of the sac, sometimes indeed completely encircling the upper as well as the outer margin (fig. 318).

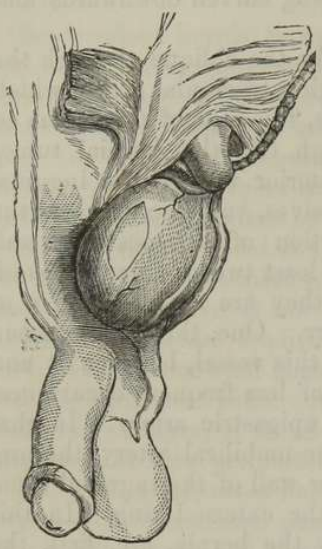
The *incomplete* or *interstitial* hernia is usually of the oblique kind, but Lawrence has observed that it may be of the direct variety. It often escapes notice, but may not unfrequently be observed on the opposite side to an ordinary inguinal hernia. Double inguinal hernia on opposite sides are of very common occurrence, and they may be of the same, or assume different forms. In some instances, as in the annexed drawing, from a preparation in the University College Museum, the two forms may be observed on the same side (fig. 317).

In females, inguinal herniæ are not common, except at advanced periods of life; they will then be seen to have the same relations as in the male, except that the round ligament is substituted for the spermatic cord.

The *symptoms* of inguinal hernia vary somewhat according to its character, whether interstitial, complete or scrotal, oblique or direct. In the interstitial

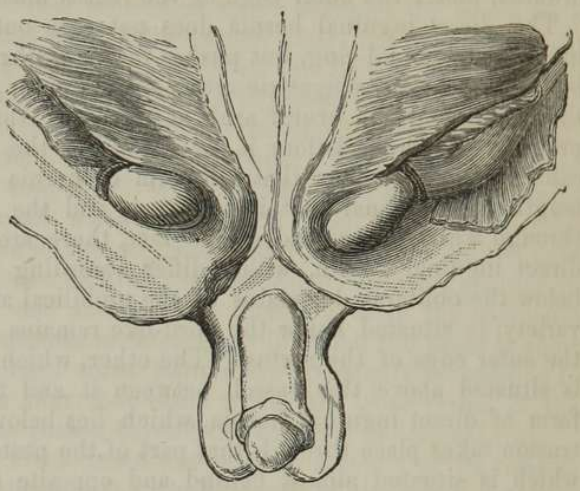
hernia, a degree of fulness will be perceived in the canal when the patient stands or coughs, and on pressing the finger on the internal ring, or passing it

Fig. 317.



Double inguinal hernia on the same side— oblique above, direct below — separated by epigastric vessels.

Fig. 318.



Double direct inguinal hernia — neck of sac crossed by epigastric artery.

up into the external ring, and directing the patient to cough, a distinct impulse, together with tumor, may be felt. In the ordinary oblique inguinal hernia, a tumor of an oblong or oval shape, oblique in its direction, taking the course of the canal downwards and forwards, will be felt protruding through the external abdominal ring, and presenting all the usual signs of a hernia. So long as it is confined to the neighborhood of the pubes, it is of moderate size; but when once it gets into the scrotum, where it meets with less resistance, it may gradually enlarge until it attains an enormous bulk. The testicle, however, may always be felt pretty distinctly at its posterior inferior part. In women this form of hernia descends into the labium, but never attains the same magnitude as in men. When of large size, these ruptures usually contain both intestine and omentum, most frequently a portion of the ileum, though the various other viscera, such as the cœcum, bladder, &c., have been found in them. In the direct inguinal hernia, the symptoms pretty closely resemble those of the oblique, except that the tumor is more rounded, and usually not so large; the neck wider, and situated near the root of the penis, with the cord on its outer side.

The different forms of inguinal hernia are not unfrequently complicated with various other affections; either with different kinds of rupture, or with diseases of the cord or testis, such as hydrocele of the cord, of the tunica vaginalis, or varicocele; these various complications necessarily make the diagnosis somewhat more obscure, but with care and practice it may generally easily be made out.

The *diagnosis of inguinal hernia* is usually readily effected, the characters and position of the tumor enabling the surgeon to determine its true nature. In most cases it is useless to endeavor to ascertain whether the hernia is oblique or direct, all old oblique herniæ having a tendency to drag the inner ring downwards and inwards, approximating it and bringing it nearly opposite to the outer one, shortening and destroying the obliquity of the canal. Hence the direction of the neck and of the axis of the tumor in these cases so nearly resembles what is met with in the direct form of hernia, that the surgeon

should not attempt to undertake the operation, more particularly the division of the stricture, on any imaginary diagnosis. Some forms of femoral hernia may occasionally be confounded with the inguinal; the distinguishing points between these two forms of the disease will be considered in the section on femoral hernia.

The diagnosis of inguinal hernia from other diseases in this vicinity has to be considered under the two conditions in which the rupture is found, in the canal, and in the scrotum. Whilst in the canal, the inguinal hernia requires to be diagnosed, — 1st. From *abscess*, descending from the interior of the abdomen or pelvis through the canal, and passing out through the abdominal ring. The diagnosis may here be effected by recognising the soft fluctuating feel of the abscess, which though reducible on pressure, and descending on coughing with a distinct impulse, does not present the more solid characters and the gurgling sensation of a hernia. 2d. From *encysted* or *diffused hydrocele of the cord*. In the encysted hydrocele there is a smooth oval swelling situated on the cord, which can be apparently reduced, being pushed up into the canal, and descends again on coughing or straining; but it may be distinguished from hernia by being always of the same size, by not being reducible into the cavity of the abdomen, by the absence of all gurgle, and by its very defined outline. In the diffused hydrocele of the cord, the absence of distinct impulse on coughing, the impossibility of returning the swelling completely within the abdominal cavity, and of feeling the cord in a free and natural state, will prevent the disease being confounded with hernia. 3d. *Fatty or other tumors* occasionally form on the cord, but the circumscribed character and limited size of these swellings, the absence of impulse on coughing, and of reducibility into the cavity of the abdomen, will point out that they are not herniæ. 4th. The *lodgement of the testis in the inguinal canal* will give rise to a tumor, which closely resembles incomplete inguinal hernia, and if it should happen to become inflamed in this situation, the difficulty of the diagnosis from strangulated hernia may be very considerable. In the ordinary undescended testis, the absence of that organ in the scrotum on the affected side, the peculiar sickening pain occasioned by the pressure of the tumor, the absence of gurgling, and of all possibility of reduction, will enable the diagnosis to be effected. A very remarkable case of inflamed testis in the inguinal canal simulating a strangulated inguinal hernia, occurred some time ago at the hospital. A man about forty, said to be laboring under strangulated hernia, was sent up from the country for operation. On being called to him, I found the house-surgeon attempting the reduction of the tumor in the hot bath; but as soon as I felt the swelling, I was convinced from its hard, solid, and irregular feel, that it was not a hernia. On inquiring into the history of the case it appears that the patient had, for the last two days, suffered from occasional vomiting, and had been constipated; that the tumor in the groin had not appeared suddenly, though it had enlarged with great rapidity, and that it was excessively painful; and that he had always worn a truss for a supposed rupture on that side, until the last few weeks, when, in consequence of the instrument breaking, he had discontinued it. On examining the groin carefully, a tumor about as large as the fist was found in the right inguinal canal; it was tender to the touch, hard, and irregular at the upper and outer part, but somewhat soft and fluctuating below; when the finger was passed into the external ring, the outline of the tumor could be very distinctly felt in the canal. There was no impulse in it on coughing, but some abdominal tenderness on that side. The right testis was not in the scrotum. I ordered the man to be bled, the tumor to be leeched, and salines administered; under this treatment the case did well.

When the hernia has descended into the scrotum, it may be confounded, 1st. With *hydrocele of the tunica vaginalis*. In this disease, there is an oval or pyriform tumor, usually translucent, unchangeable in size or shape by pressure, and

having the cord clear and distinct above it, with an absence of impulse on coughing, or of gurgling in attempts at reduction. In cases of congenital hydrocele in children, in which there is still an opening communicating with the peritoneal cavity, the tumor may be diminished in size, by steady pressure, but gradually returns again, fluctuates, and is translucent. In these cases its translucency, the gradual manner in which the sac is emptied, and is refilled, so different from the sudden slip up and protrusion of a hernia, enable the surgeon to establish the diagnosis. It not unfrequently happens that hernia is complicated with hydrocele of the tunica vaginalis. In these cases, the two separate tumors can usually be distinguished, there being some degree of constriction, or of consolidation, between them. The hydrocele will present its ordinary characters of translucency, irreducibility, and circumscribed outline, and is commonly placed anterior to the hernia, which lies towards the back of the scrotum, and may be distinguished by its reducibility and impulse on coughing. It sometimes happens, as in a case which recently fell under my observation, that a hydrocele of the cord is associated with one of the tunica vaginalis, and a hernia; under such circumstances, the diagnosis requires a little care, but may be effected readily enough by separately determining the characters of the different swellings. 2d. From *varicocele*, the diagnosis may be effected in the way pointed out by Sir A. Cooper. The patient should be placed in the recumbent position, and the swelling reduced; the surgeon then presses upon the external ring with his fingers, taking care to cover the whole of it, and desires the patient to stand up. If it be a hernia, the tumor cannot descend, but if a varicocele, it will speedily reappear, *whilst the pressure is being kept up*, the blood being conveyed into it through the spermatic arteries. 3d. *Tumors of the testis* may be distinguished from hernia by their solid feel, rounded shape, by the absence of all impulse on coughing, and, especially, by the cord being felt free and clear above them, and the inguinal canal unoccupied. 4th. In *hæmatocele*, the cause of the swelling, its pyriform shape, opacity, solid feel, the absence of impulse on coughing, and the defined characters of the cord, will enable the surgeon to make the diagnosis.

Treatment of inguinal hernia. — When reducible, the rupture must be kept up by a well-made truss, the pad of which, of an oval shape, should press not only upon the external ring, but upon the whole length of the canal. When irreducible, and of large size, nothing can be done beyond supporting it in a bag-truss.

When strangulated, if the taxis properly employed in the direction of the canal has failed, the operation must be proceeded with in the following way: — The bladder having been emptied, and the pubes shaved, the patient should be brought to the edge of the bed, and the surgeon, standing between his legs, and having the skin covering the external ring well pinched up, divides the fold in the usual way, by an incision three inches in length, commencing about an inch above the external abdominal ring. Should any spouting vessels, as the superficial external pudic, be divided in this incision, they had better be ligatured. The surgeon then proceeds with the section through the subcutaneous structures; he will find in many cases the superficial fascia considerably thickened, more particularly if the patient has long worn a truss. He divides this structure in the line of the external incision, and then exposes the inter-columnar fascia, which will also generally be found thickened and incorporated with the superficial fascia. In many cases, the inter-columnar fibres will be found condensed into a thick and broad fillet, which limits the further extension of the ring, and produces an evident constriction upon the neck of large inguinal herniæ. An opening should be carefully made into this fascia, a grooved director passed under the edge of the ring, and this slit up. In some cases, though but very rarely, it will now be found that the hernia may be reduced, its strangulation depending on the constriction of the margins of this aperture; most com-

monly, however, the stricture is situated deeper than this. The cremasteric fascia, which is generally considerably thickened, is now exposed, when its fibres will be found to form a kind of reticulated mesh over the hernial tumor. This stricture must be carefully divided upon a director, when the subserous cellular tissue, or fascia propria, will be laid bare. This structure is usually thickened and vascular, and not unfrequently the stricture appears to be situated in it, or in a kind of condensed ring formed by the incorporation of it with the meshes of the cremaster. If it be found, after the division of these fasciæ, that the stricture has been removed, and the hernia can be reduced, it would of course be unnecessary to lay open the sac, and the safety of the patient will be considerably enhanced, more particularly if the operation is performed for an old scrotal hernia of large size, by not doing so. If, however, as will happen in the majority of instances, in inguinal hernia, it will be found that the stricture is in the neck of the sac itself, occasioned by a condensation, constriction, and puckering of it, the sac must be carefully opened at its anterior part, the finger introduced, and the stricture divided from within, by pressing the finger-nail under it, and cautiously sliding the hernia-knife along this. It is an established rule in surgery, that this division should be effected in a direction immediately upwards, so that it may lie parallel with the epigastric vessels, whether it be situated upon the inner or outer side of these. It is true that if the surgeon could be sure that he had to do with an oblique inguinal hernia, he might safely divide the stricture outwards, or, if he was certain that the protrusion was of the direct kind, he might make the section inwards; but, as it commonly happens that he cannot determine with absolute certainty which hernia he is operating upon, he adopts the safer plan recommended by Sir A. Cooper and Lawrence, of cutting upwards from the middle of the ring parallel to the epigastric vessels.

The seat of stricture in inguinal hernia will thus be seen to differ in different cases, and in some instances it exists in two situations. I think it most commonly occurs in the neck of the sac, owing to contraction and elongation of it with condensation of the subserous cellular tissue lying immediately upon it. In other cases, though much more rarely, it seems to be formed by a thickening of the transversalis fascia at the inner ring, but altogether outside the sac; occasionally it is met with in some part of the canal, at the lower edge of the internal oblique, but much more frequently at the external abdominal ring. In many cases there is very tight constriction in this situation, as well as in the deeper portions of the canal, or at the inner ring; hence after the division of any stricture at the external abdominal ring, the deeper portions of the canal should always be carefully examined before any attempt is made to put the hernia back.

The operation for an incomplete inguinal hernia requires to be conducted in the same way as that which has just been described, except that the incision need not be quite so long, and should not extend beyond the external ring. After this has been laid open, and the tendon of the external oblique slit up, a flat director must be passed under the lower edge of the internal oblique and transversalis muscles, which must be carefully divided; should the stricture not be relieved in this way, and the sac require to be laid open, the deep section must be made in the same way and in the same direction as has already been described.

Inguinal herniæ, which contain either the cæcum, the sigmoid flexure of the colon, or the urinary bladder.—In these cases the protruded viscera are only partially covered by peritoneum, hence in operating upon such herniæ, when strangulated, care must be taken that the intestine be not wounded, which is apt to occur, in consequence of the surgeon dividing the parts without due caution, not suspecting himself to be in the neighborhood of the gut, in consequence of his not having reached a sac, which does not exist. As the pro-

truded parts are generally adherent in these cases, the surgeon must content himself with leaving them unreduced after the division of the stricture; under such circumstances, it has happened that the protrusion is ultimately drawn back into the abdomen by some natural action of the parts.

Operations for strangulated inguinal hernia are required during a greater range of ages than those for any other kind of protrusion. I have operated successfully for congenital hernia in infants less than six weeks old, and for an ordinary oblique inguinal hernia in one four months of age, and it has been done on centenarians. When small and recent, the protrusion usually consists of intestine only; when large it commonly contains omentum as well. The treatment of these contents, and the after management of the case, must be conducted in accordance with the rules laid down at page 785, *et seq.*

Hernia of the tunica vaginalis or *congenital hernia.*—In this case the hernia descends inside the tunica vaginalis, which constitutes its sac. It is always oblique, and takes the course of the spermatic cord; most commonly descending into the scrotum, but sometimes lying within the canal, out of which, perhaps, the testis has imperfectly passed. This hernia differs from an ordinary oblique hernia in the absence of a true peritoneal sac, and in the protruded parts lying in the tunica vaginalis and in contact with the testicle (fig. 319). The great peculiarity, indeed, of this hernia consists in its descending along the canal, left open by the descent of the testis. It is well known that in the fœtus the testis originally lies below the kidney, and as it descends in the later months of fœtal life into the inguinal canal and scrotum, it pushes before it a prolongation of the peritoneum, exactly resembling a hernial sac.

That prolongation of the peritoneum which is carried down around the testis in its descent, may be divided into two portions, the funicular and the testicular. The *funicular* being that which corresponds to the cord, extending from the internal ring to the scrotum; the *testicular* being that which becomes the tunica vaginalis. A congenital hernia occurs in consequence of the funicular prolongation not becoming, as in the normal condition, converted into a filamentous fibro-cellular tissue, but remaining pervious, and thus serving as a medium of communication between the general cavity of the peritoneum and the tunica vaginalis, and along the open channel thus left the congenital hernia descends. The reason why in many cases the hernia is not truly congenital, but occurs in after-life, is that the funicular portion is only partially closed or contracted, and that under a sudden effort this septum is broken through, and thus the gut falls into the tunica vaginalis.

Fig. 319.

Congenital hernia.

Fig. 320.

Infantile hernia.

Hernia of the tunica vaginalis, though usually called "congenital" is rarely so in reality; the tendency is congenital, but the disease is not. It not unfre-

quently happens, it is true, that these herniæ show themselves early in life, in infants a few weeks or months old; though at these ages even the funicular prolongation of the peritoneum may be so completely occluded, that the hernia which occurs is of an ordinary oblique character. Not unfrequently, however, the hernia does not take place until a considerably later period of life than this, and may suddenly happen in the adult; thus, Velpeau relates instances in which it occurred for the first time between the ages of eighteen and twenty-five. I lately operated in a case on a man thirty-five years of age, in whom this kind of hernia occurred for the first time when he was twelve years old; and some years ago, in a case at the Hospital, on a man about fifty, in whom, on the most careful inquiry, it would appear that the protrusion had not shown itself until he was about thirty years of age.

The *symptoms* of hernia in the tunica vaginalis closely resemble those of the ordinary oblique; most commonly, however, the scrotal tumor is much rounded, and the neck feels narrow and constricted. The testis, also, cannot be felt distinct and separate from the tumor, but is surrounded by, and, as it were, buried in the substance of the hernia, through which it may sometimes be felt at the lower and back part of the scrotum.

When an undescended testis is complicated with congenital hernia in the inguinal canal, much difficulty may occur in effecting the diagnosis. In a case of this kind to which I was lately called by my friend Dr. Pretty, there could be felt behind and above an inflamed and swollen testicle, which lay at the external abdominal ring, a small, hard, round tumor in the upper portion of the canal; as symptoms of strangulation were urgent, this was cut down upon, the anterior wall of the canal incised, and the tunica vaginalis, much distended with fluid laid open, when a small knuckle of intestine was found lying at its upper part, very tightly constricted by the inner ring.

The *treatment* of congenital hernia consists in the reduction of the tumor and the application of a proper truss, the pad of which should compress the whole length of the inguinal canal. In some cases, in children, a radical cure may be effected in this way; but in order to accomplish this desirable result, the truss must be worn for at least a couple of years. The application of a truss with an air-pad will in many instances be found especially useful, more particularly in children, in whom it applies itself with greater exactness than an ordinary incompressible one.

When strangulated, the congenital hernia does not commonly admit of reduction, and thus necessarily renders an operation imperative. This procedure is more commonly required for this kind of hernia in adults than in infants. During the last five years I have operated on 12 cases of congenital hernia; of these 7 were on adults from twenty-two to fifty years of age; 1 on a lad of fifteen; 1 on a child of four months; and 3 on infants under six weeks of age. The operation is the same as that for oblique inguinal hernia, but the parts concerned are usually thinner, the tunica vaginalis serving for a sac; hence more caution than usual is required in these cases. The sac commonly contains a large quantity of clear dark-colored fluid, there being, in fact, a hydrocele conjoined with the hernia. The stricture will, I believe, always be found in the neck of the sac, which appears to be condensed, elongated, and narrowed; hence it is useless in these cases to endeavor to relieve the strangulation, without laying open the sac, and dividing its neck from within. As the congenital hernia is always external to the epigastric vessels, the section of the stricture may be done with perfect safety in a direction upwards and outwards; though, if the surgeon should have any doubt as to the exact nature of the case, it will be better to divide the stricture directly upwards. The reduction of the contents of the hernia will often be prevented by adhesions in the neck of the sac, or between them and the testes. I have found both the gut and omentum closely incorporated with this organ, and requiring some nice dissection to separate

them. In operating upon infants of a very tender age, much caution will necessarily be required, on account of the density of the coverings, their tension, and the small size of the apertures. The testes, as well as the spermatic cord, the veins of which are excessively turgid, will usually be found much congested, and of a black or bluish-black color.

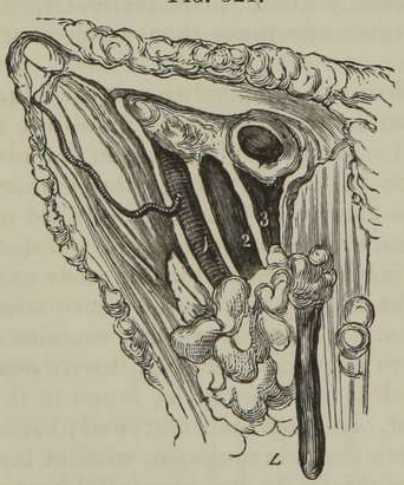
A species of congenital hernia has been met with in the female, especially in children, in which the protrusion takes place into the canal of Nuck, which invests the round ligament. In one instance I have seen a double inguinal hernia in a girl of five years old. It is of extremely rare occurrence, and requires the same treatment as the corresponding disease in the male.

The *encysted hernia of the tunica vaginalis*, or *infantile hernia*, as it has been somewhat absurdly termed, occurs in those cases in which the funicular portion of the tunica vaginalis is partly obstructed by a septum, or by being converted into filamentous tissue, but in such a way as to leave a pouch above, which is protruded down behind or into the tunica vaginalis, so that it lies behind this cavity (fig. 320). There are no characters by which the encysted can be distinguished from the ordinary congenital hernia. If it should become strangulated, it must be borne in mind that, during the operation, the tunica vaginalis will first be opened; no hernia will be seen here, but the tumor lies behind this sac, and requires to be dissected into through the double serous layer of which it is composed. The stricture would probably be in the neck, and requires to be divided in the usual way.

FEMORAL HERNIA.

By femoral hernia is usually meant a protrusion that escapes under Poupart's ligament, and enters the sheath of the vessels internal to the femoral vein. This hernia passes down into the innermost compartment of the sheath, which is occupied by fat and lymphatics, and usually contains a gland or two. It passes first of all through the crural ring, where it has Gimbernat's ligament to its inner side; the septum, which separates the femoral vein from the inner compartment of the sheath of the vessels to its outer aspect; Poupart's ligament in front, and the bone behind (fig. 321). After passing through the crural ring, it enters the crural canal, which extends for about an inch and a half down the thigh on the pectineus muscle, and is covered by the iliac prolongation of the fascia lata. As it approaches the lower corner of the saphenous opening, where the canal terminates, it passes under the falciform process of the fascia lata, and out upon the thigh through the saphenous aperture; here it expands, becomes rounded, and has often a tendency to turn upwards over Poupart's ligament (fig. 323), lying in this way upon the iliac region, and sometimes even ascending to some distance upon the anterior abdominal wall. In the descent of the hernia through this course, it first of all pushes before it the peritoneal sac, and then receives an investment of the subserous cellular tissue. It next comes into relation with the *septum crurale*, a mass of dense cellular tissue, containing fat and lymphatics, occupying the crural ring. This septum often becomes incorporated and matted with the contiguous portion of the

Fig. 321.

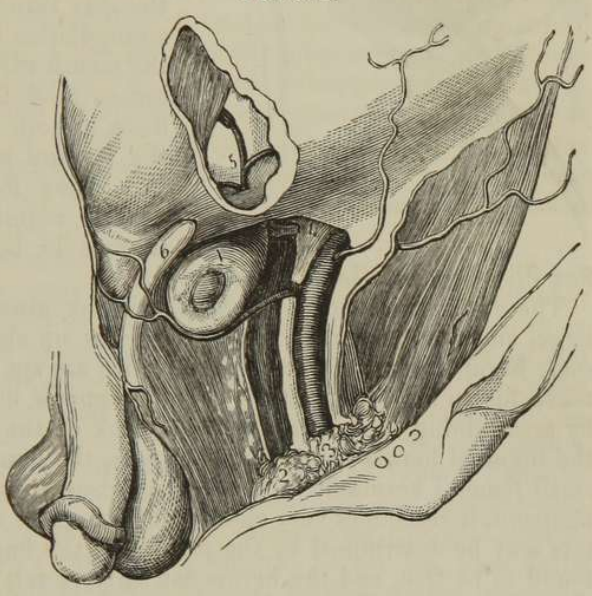


1, Femoral artery; 2, femoral vein; 3, innermost compartment of the sheaths of the vessels into which a small hernia is protruding; 4, saphena vein.

sheath, thus constituting the *fascia propria* of this hernia, which is commonly thickened, laminated, and of an opaque fatty structure, like omentum. As the hernia continues to descend, it comes into relation with the cribriform fascia, which occupies the saphenous opening, and, lastly, pushes before it the integumental structures.

As the tumor descends through this course, it necessarily comes into relation with very important parts (fig. 322). Thus it is separated from the femoral vein solely by the septum of the sheath of the vessels. It has the epigastric artery above and to its outer side, and the spermatic cord in the male, or round ligament in the female, almost immediately above it. The obturator artery, when arising in the normal manner from the internal iliac, does not come into relation with the neck of the sac; but when it takes its origin, as it not unfrequently does, from the external iliac, the common femoral, or the epigastric, it may have important relations to this part of the hernia. Most commonly, under these circumstances, it passes to the iliac or outer side of the neck, but occasionally it winds round its inner or pubic side, coming into pretty close relation with it, and then, as will immediately be mentioned, may be in considerable danger during the operation. The combination, however, of this particular variety of the obturator artery and femoral hernia, is a very uncommon occurrence, because, in the first place, this internal distribution of the artery is rare; and when it does occur, as it passes directly over that portion of the crural ring through which the sac would protrude, it necessarily strengthens this, and so diminishes the chance of rupture.

Fig. 322.



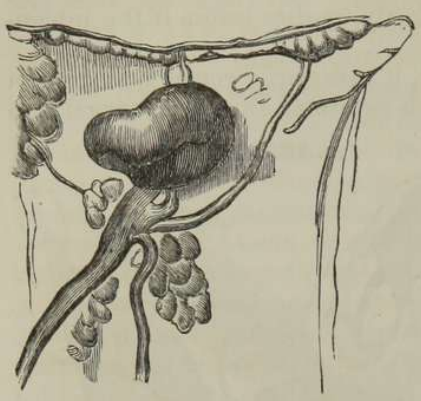
1. Femoral hernia; 2, femoral vein; 3, femoral artery, giving off, 4, common trunk of epigastric and obturator arteries; 5, epigastric artery; 6, spermatic cord.

The contents of a femoral hernia are usually intestinal, and most commonly consist of a portion of the ileum. Occasionally omentum is contained within the sac, but seldom in large quantity. I have, however, several times had occasion to operate in cases of old femoral hernia, in which it became necessary to remove large portions of adherent omentum, in one, ten and a half ounces, and in the other, about seven. In each case there was a small knuckle of intestine, strangulated behind the omentum. The ovaries, Fallopian tubes, &c., have been known to be strangulated in this variety of hernia.

The *symptoms of femoral hernia* are usually well marked, they consist of a tolerably firm, tense, and unyielding tumor, of a rounded shape, situated in the groin, to the inner side of the femoral vessels, having its neck under Poupart's ligament, though as it increases in size its base may be turned above this structure; sometimes, though rarely, it passes downwards upon the thigh. Its size varies considerably, most commonly it is not larger than a walnut or a pigeon's egg, and then is deeply seated in the angle between the body of the pubes and the femoral vessels, but occasionally it may attain a considerable bulk, as large as the fist or a French roll; when large, this hernia usually rises up above Pou-

part's ligament, and extends outwards in a direction parallel to it, so that it assumes an elongated shape; it is then usually somewhat doughy and soft, even when strangulated; very different from the excessively tense feel that it has when small.

Fig. 323.



In some rare cases the femoral hernia has been found lying external to the vessels, the mouth of the sac being between them and the iliac spine. Under these circumstances strangulation cannot well occur, inasmuch as the mouth will be the widest part of the sac; but, as Hesselbach has observed, if the fascia iliaca be torn by the pressure of the tumor, the rupture may be strangled in the aperture thus formed. Should an operation ever be required under such circumstances, it must be borne in mind that the circumflex ilii artery may be in some danger.

The *diagnosis of femoral hernia* is not always easy. When the hernia is large, and more particularly when it rises up above Poupart's ligament, which some herniæ, even of very moderate size are apt to do, it might at first be mistaken for an inguinal rupture. The diagnosis, however, may always be effected by ascertaining the relation that the neck of the sac has to Poupart's ligament, the inguinal hernia being situated *above*, the femoral *below* this cord. When a small femoral hernia in a fat subject rises upwards, so as to overlay Poupart's ligament, it resembles very closely an incomplete inguinal hernia, but its characters may be determined by the passage of the finger up the canal, which will be found to be free, and the hernia can only be felt through its posterior and inferior wall. After reducing a femoral hernia, the finger also can usually be pushed into the inferior aperture of the crural canal, when the situation and sharp outline of the falciform process will determine the nature of the opening through which the protrusion has occurred.

The diseases occurring in the groin, with which femoral hernia may most readily be confounded, are — 1st. *Enlarged lymphatic glands* in this situation. From these it may be distinguished by the absence of impulse in the glandular tumor, and by the simultaneous enlargement of several glands. A small strangulated hernia may however co-exist with these, being subjacent to, and covered in by them. When this is the case, and the local signs of hernia are obscure, whilst the symptoms of strangulation continue, an incision should be made into the part, and the dissection carefully carried through and underneath the glands, with the view of determining whether the hernia exists or not. 2d. *A small fatty growth* has been met with in the crural canal, simulating closely a hernia; the want of impulse on coughing, together with its limited and doughy character, and the absence of circumscription in the tumor, will enable the surgeon to distinguish it from hernia. 3d. *Psoas abscess* not unfrequently points very nearly in the situation of femoral hernia: from this it may however be distinguished by its fluctuating feel, soft yet semi-elastic character, and by the general history of the case. The impulse on coughing, which is very distinct in the abscess, is commonly more forcible and direct than that of a hernia; and although the purulent collection may in many cases be squeezed back into the abdomen when the patient lies down, yet it returns without a gurgle, and without that distinct slip which accompanies the reduction of a hernia. 5th. *Varix of the saphena vein* is in some danger of being confounded with hernia. It may, however, be distinguished from this by the impulse in it being less distinct, and by the enlargement of the lower part of the vein being marked in the varix, but not existing in the rupture.

Femoral hernia most commonly occurs in women, and very seldom under the age of twenty; differing in both these respects from the inguinal rupture. Sir A. Cooper states that he had only seen three cases under the above age. It very seldom becomes strangulated at an early period of life, even when existing. I have lately had a girl of nineteen under my care with femoral hernia, in whom strangulation had already occurred on four occasions, reduction, however, having been happily effected each time.

The *treatment* of femoral hernia when reducible must be conducted in the ordinary way by the application of a proper truss. A cure, however, is never I believe effected by the pressure of the pad, as sometimes happens in inguinal hernia, owing probably to the rigidity and incompressibility of the tendinous and aponeurotic structures through which this rupture protrudes. It is difficult to keep this form of hernia up by means of a truss. The best instrument for this purpose is, I think, the "mocmain truss," which I have found succeed when all others have failed. When the hernia is irreducible it should be supported by means of a truss with a concave pad.

When a femoral rupture is strangulated, reduction should be effected either by taxis or operation as speedily as possible, gangrene more rapidly ensuing in this than in any other form of hernia. In attempting the taxis the structures in the groin should be well relaxed by bending the body forwards and flexing the thigh upon the abdomen; if it do not succeed with the assistance of the means recommended at page 778, the operation should be proceeded with at once. The operation for strangulated femoral hernia may be undertaken earlier and with a better prospect of success than that for any other form of rupture; this is owing to the stricture being so commonly seated outside the sac, that the operation usually admits of being completed without implicating the peritoneum. The advantage of this mode of procedure in femoral hernia has been fully pointed out by A. Key, Luke, and Gay, and is now, I think, pretty generally recognised and practised. Mr. Gay more particularly, in his Work on Femoral Hernia, has pointed out that the stricture may commonly be divided without opening the sac, by making a very limited incision on the inner side of the neck of the tumor; and he justly observes that the operation undertaken in this manner is little more than the taxis with the addition of a superficial incision.

The stricture in femoral hernia is often found to be occasioned by the pressure of the crural arch. Lawrence states that it may be most effectually relieved by dividing the thin posterior border of this arch near the pubes. Other surgeons recommend that the sharp edge of Gimbernat's ligament should be divided, and others again that the division should be made at the junction of Gimbernat's and Poupart's ligament through those ligamentous bands that go by the name of Hey's, or the ilio-femoral ligament, or, at the inner edge of the falciform process; and indeed it is in this situation that both Lawrence and Hey direct the division to be made. In operating for femoral hernia, I have certainly most frequently found the stricture still to continue after the division of these ligamentous structures, and to be occasioned by fibrous bands often very distinct, narrow, and glistening, lying across the neck of the sac in the fascia propria of the hernia; and I agree with the opinion expressed by Sir A. Cooper, that the neck of the sheath is the common seat of strangulation in femoral hernia; these transverse fibres which sometimes appear to be partially reticulated, consisting probably of a condensation of the tendinous fibres that are normally found in the sheath of the vessels. In order to expose them it is commonly necessary to draw the neck of the sac well down, when they will be seen deeply to indent and constrict it.

The operation without opening the sac may most conveniently be performed, when the tumor is of small size, by making an incision along the inner side of its neck and then dissecting through the superficial structures until the fascia propria is exposed and carefully opened, the finger nail or a flat director may

then be insinuated under the sharp edge of Gimbernat's ligament, which at the point of junction with Poupart's, may be divided upwards and inwards to the extent of a line or two by means of a hernia knife. The reduction may now be attempted, and often effected; should any obstacle exist, the neck of the sac must be well drawn down and exposed, and any transverse bands situated upon it dissected through with the scalpel and forceps. I have on many occasions found it necessary to do this before reduction could be effected.

The operation performed in this way is certainly a very simple procedure, and adds little to the danger of the patient. If it be thought desirable to open the sac, the operation must be performed in a different manner, the parts requiring to be pretty fully exposed; and indeed, if the tumor be of any considerable magnitude, even though the sac be not opened, it will be better to expose the part somewhat more freely in the way to be described. An incision should be made parallel to Poupart's ligament, by pinching up the skin, and then a transverse cut from the centre of this carried over the tumor so as to present the following shape : the dissection must then be carried through the superficial fascia, when the septum crurale or fascia propria will be exposed; in some cases, especially if the hernia be a large one, this is thin, and requires to be carefully slit up on a director. In many instances, however, it is so dense, laminated, and changed in structure, as scarcely to be recognised for what it is. It not unfrequently happens that after the superficial fascia has been divided, an oval, smooth, and firm body is exposed, which at first looks like the hernial sac, or a lump of omentum; this is in reality the fascia propria, thickened by the long-continued pressure of the truss, and congested perhaps by the attempts at reduction; and in the midst of this, the sac will at last be found after the dissection has been carried through several layers of this tissue. In it occasionally cysts containing bloody serum may be found, and then the difficulty in the recognition of the structure is greatly increased. Though the mobility of this mass, the facility of tracing its neck, and the roundness of its general outline, often cause it to be mistaken for sac or omentum, it may be distinguished from the first by the absence of the characteristic vessels upon its surface, and from the second by its more rounded, solid feel, and uniform appearance. When the sac has been reached, it must be very carefully opened, there being usually very little, if any fluid between it and its contents; the finger-nail must then be passed under the sharp edge of the stricture, which should be divided in a direction upwards and inwards. The reason why this line of incision is universally chosen by surgeons in this country at the present day is, that it is the only direction in which the stricture can be divided without risk of inflicting serious injury upon neighboring parts. If the section be made outwards, the femoral vein would be in danger; if upwards and outwards, the epigastric artery; if directly upwards, the spermatic cord: hence the only direction is either inwards, or upwards and inwards. If the cut be made inwards, the sharp edge of Gimbernat's ligament alone will be divided, and the crural arch not sufficiently liberated. But if the division be made upwards and inwards, the ilio-femoral ligament will be divided, and thus the tension of the whole of the arch lessened; the only danger that can occur from the division of the stricture in this direction is the very remote one of the division of the obturator artery, when it takes the anomalous course round the inside of the neck of the sac. Mr. Guthrie states that he has known some of the best surgeons in London lose patients by hemorrhage after the operation for femoral hernia. This accident, however, must be of extremely rare occurrence, and might in a great measure be guarded against by slightly blunting the edge of the hernia-knife before dividing the stricture, so that the tense fibrous bands constituting the constriction would yield, but the artery probably escape, being pushed before the blunted edge. I have however more than once seen blood well up pretty freely on the division

of the stricture, but it has ceased spontaneously, and I have never known it give any trouble. If the division of the stricture is limited to a line or two, there will be but little danger of wounding the vessel, even when it takes the abnormal course.

It will generally be found that the intestine contained in the sac of a femoral hernia is dark colored and tightly nipped; it requires to be treated in accordance with the general principles that guide us in the management of hernia.

UMBILICAL HERNIA.

By *umbilical hernia* or *exomphalus* is meant a protrusion through the umbilical aperture. This is sometimes congenital, and when so, it has happened that the protrusion has been included in and accidentally strangulated by, the ligature applied to the umbilical cord. More frequently, however, it occurs a few months after birth in consequence of the child straining or crying. In these cases it is readily recognised by a smooth, rounded, and tense tumor, starting forwards at the umbilicus, readily reducible on pressure. The treatment should consist in keeping the tumor reduced by the application of an elastic India-rubber belt with an air-pad that presses firmly upon the aperture; or should such a contrivance as this not be at hand, the reduction may readily enough be effected by applying a piece of soap-plaster spread on amadou, over the aperture, upon which a well-padded slice of cork may be tightly strapped. It most commonly happens that after pressure has in this way been kept up for some months, a radical cure results.

Umbilical hernia in adults most frequently occurs in women, especially those who have borne many children, or who are loaded with internal fat. It is by no means unlikely that the tendency to this disease is often established in childhood, but does not become developed until the abdominal muscles have been weakened and the umbilical aperture relaxed by the pressure of the gravid uterus.

The umbilical rupture usually attains a considerable bulk, and often acquires an enormous size; when large it is commonly irregular or semilunar in shape, sometimes appearing to be composed of several distinct tumors. It is usually partly doughy and partly tympanitic to the feel, has a distinct impulse on coughing, and is readily reducible; not unfrequently it happens, however, that a portion of the rupture continues irreducible, owing to the existence of adherent omentum. The coverings of an umbilical rupture are usually extremely thin, consisting merely of the peritoneum, a layer of condensed fascia which is often perforated at several points by circular openings through which the hernia protrudes, and the integuments containing the umbilical cicatrix, which is expanded over the part.

The *treatment* consists, if reducible, in wearing a properly constructed truss; if irreducible, in applying a hollow cup-shaped pad supported by a bandage over the part. It not unfrequently happens that an irreducible umbilical rupture in old women becomes obstructed, being attended with tension of the protrusion, with nausea and constipation. In these cases much discrimination will be required to avoid confounding this condition of the tumor with strangulation of it. This may be done by attention to the rules laid down (page 777), when by local blood-letting, fomentations, and aperients, relief may usually be afforded. Should, however, the bowels not speedily act, and should the tumor continue irreducible, it will, I think, be better to cut down upon it, and treat it as a strangulated hernia, dividing adhesions and reducing the swelling; for if it be left obstructed and unreduced, the whole tumor may run into a state of gangrenous inflammation, under which circumstances operative interference will be of little use.

The stricture should, if possible, be divided without opening the sac. This

may usually be accomplished by drawing the tumor well down and then making an incision about two inches in length over the neck and its upper part in the mesial line. If the tumor overlaps here it may be more convenient to make the incision by the side or even between, but as a general rule the upper part is the best. After the division of the integumental structures and often of a deep layer of fat, the end of the nail may be slipped under the edge of the sharp circular margin through which the protrusion has occurred, and the stricture being divided away from the sac, and if possible in the mesial line, reduction may be readily and safely accomplished. Should the strangulation not be thus relieved, the sac must be opened, and any stricture divided from within. But the surgeon should exhaust every means before he opens the sac of an umbilical hernia, especially of large size, the patient I believe rarely recovering when this is done, — much less frequently, so far as my experience goes, than in other forms of hernia. Sometimes after the external division of the stricture it will be found that there is an internal strangulation in these herniæ, the gut having slipped through an aperture formed I believe in the condensed fascia covering the sac; if so, the edge of this sharply-defined opening may require division. Sir A. Cooper mentions an umbilical hernia forming two tumors, having a communication between them; and South relates a case in which the tumor resembled a figure of 8, a dense cellular band binding down the middle of the sac. In such cases as these, which are by no means uncommon, central constriction may require to be divided as well as the stricture at the neck of the sac. Adherent omentum had, I think, better be left in the sac in cases of umbilical hernia, and gangrenous intestine or omentum must be treated upon general principles. It is not often that strangulation of an umbilical hernia occurs during pregnancy, but should this happen, the operation must be performed as usual; that condition not complicating the case much; and instances are recorded by Sir A. Cooper, Lawrence and others, of its successful performance at this period. After the division of the strictures and the reduction of parts, a large and very thick compress must be laid over the loose folds of integument in the site of the hernia, and be retained in position by a broad and firmly applied flannel roller.

OTHER VARIETIES OF HERNIA.

Ventral hernia. — By ventral herniæ, are meant those protrusions that occur through any part of the abdominal wall, except the inguinal, the femoral or umbilical apertures; they most commonly occur in the mid-line between the recti muscles, the linea alba appearing to have given way in this situation during parturition, and here they may attain an immense size. A case was lately sent to me from the country in which there was a long triangular gap through the upper part of the abdominal wall, extending from the umbilicus to the ensiform cartilage, through which a protrusion had taken place that was nearly as large as an adult's head. These ruptures have also been met with in the lineæ semi-lunares, the hypochondriac and iliac regions; and Cloquet describes a case occurring in the lumbar region. When these herniæ happen in the vicinity of the stomach, they are apt to occasion dyspeptic symptoms and much gastric irritation; but Lawrence is doubtless right in thinking that these symptoms do not arise from the implication of the stomach, but simply from irritation of it. These different protrusions have occasionally been met with as the result of injuries, by which the anterior abdominal wall has been lacerated; indeed they seldom, if ever, take place below the umbilicus, unless arising from a directly traumatic cause.

The *treatment* of ventral hernia must consist in supporting the tumor by means of a broad belt and properly constructed pad. Should they become strangulated, which I believe very rarely happens, owing to the width of the

neck of the sac, the operation must be performed in the same way as for umbilical rupture, care being taken to divide cautiously the integuments, any aponeurotic investments, and the peritoneal sac: the stricture should always be divided upwards in the mesial line.

A rare kind of ventral rupture has been described, principally by the German surgeons, in which the abdominal wall has yielded to a considerable extent, forming a broad and expanded tumor, without any distinct neck or pedicle. Sometimes these tumors may attain an immense size, stretching perhaps down to the knees, and containing even the gravid uterus.

Obturator hernia.—The occurrence of this form of hernia is extremely rare, and its existence has still more rarely been determined until after death; in fact Lawrence seems to doubt the possibility of the recognition of this complaint during life, in consequence of the small size which the tumor attains, and its being covered in by and compressed under the pectineus muscle. Two instances have, however, lately been recorded, one by Mr. Obré, the other by Bransby Cooper, in which a strangulated hernia of this kind was recognized during life. And these are probably the only instances on record in which an operation has been successfully performed; almost all the other cases mentioned by writers having been accidentally discovered after death, which had occurred from internal strangulation, the precise seat of which could not be detected. In Mr. Obré's case, the patient was seized with symptoms of strangulation, but no tumor could be detected in any of the ordinary seats of hernia. "On uncovering the upper part of both thighs at the same time, the eye detected a slight degree of fulness in Scarpa's triangle on the right side; this triangle of the opposite limb was well marked with a hollow, or depression passing down its centre, but this was lost on the affected side, and the whole contour of this part of the limb was visibly fuller than that of the corresponding one. There was no tumor or circumscribed swelling, but on standing over the patient, and using firm pressure with the ends of the fingers over the neighborhood of the femoral artery, and a little below the saphenous opening, a distinct hardness could be felt (slight in its extent), giving an impression as if the sheaths of the vessels were being pressed on." Taking the dangerous state of the patient into consideration, Mr. Obré acting in accordance with the best rules of surgery, and thinking that there might be a hernia deeply strangulated in the femoral canal, made an incision downwards in this situation, but was disappointed on finding, when the saphenous opening was exposed, that there was no intestine confined there; but as a hardened structure could be deeply felt at the inner border of the opening, the fascia lata was exposed, and the pectineus divided to the extent of about two inches, when a hernial sac about the size of a pigeon's egg, and containing intestine came into view. In this operation the saphena vein gave some trouble, lying as it did in the course of the incision. The sac having been laid open, the stricture was divided upwards, during which part of the procedure the vein was accidentally cut, and required ligature; no other vessel was tied. The operation, which reflects the greatest credit on Mr. Obré's diagnostic skill and dexterity, was perfectly successful, the patient making an excellent recovery.

Besides the obturator, various other pelvic herniæ may take place, such as a protrusion into the perineum, the vagina, or through the sciatic notch. These various forms of rupture are of extreme rarity, and present many difficulties in their diagnosis.

Perineal hernia commonly occurs in the middle line, between the rectum and the bladder in men, or the rectum and vagina in women, but sometimes the protrusion has been known to take place by the side of the anus, or even in front of this. Of these various forms of rupture many instances have been collected by Lawrence from different writers. The treatment of such a hernia would consist in supporting the protrusion by means of a pad and bandage; as

the mouth of the sac is very large in these cases, it is not probable that any strangulation would occur.

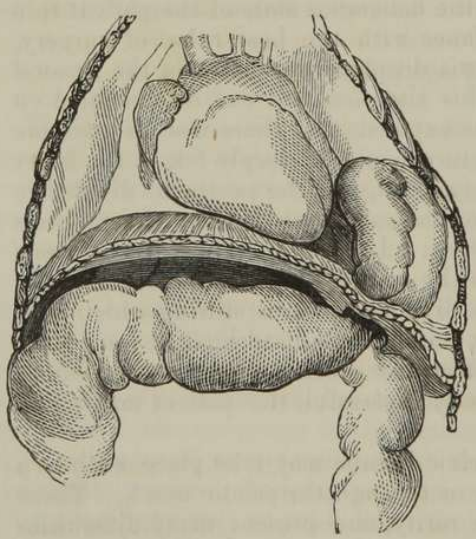
Vaginal hernia has occasionally been met with, the tumor protruding through the posterior or upper wall of the vagina, and presenting the ordinary characters of this disease, such as impulse on coughing and reducibility. It may most conveniently be kept up by means of a sponge pessary.

Pudendal hernia has been described by Sir A. Cooper as very closely resembling vaginal rupture. The situation of the tumor may cause it to be mistaken for an inguinal hernia, but from this it may be recognized by the upper part of the labium and the ring being completely free, whilst a tumor presenting the ordinary characters of a rupture is situated in the lower part of the labium, and forms a prominence extending along the side of the vagina.

Sciatic hernia. — This rare form of hernia has been described by Sir A. Cooper as passing through the sciatic notch, where it lies between the lower border of the pyriform muscle and the spine of the ischium. It lies in close relation with the sciatic nerve, and with the internal iliac vessels. In the case related by Cooper, the obturator artery passed above, and the vein below the neck of the sac. From the depth at which such a hernia would be seated, and its small size, it would probably escape observation during life, but if detected it might readily be retained by means of proper bandages and a pad. Should operation ever be required in case of strangulation, the deep incisions must be carefully conducted, on account of the great importance of the parts surrounding the sac.

Diaphragmatic hernia.—This form of hernia is of unfrequent occurrence, and I believe always results in consequence of a wound or laceration of the diaphragm. It usually attains a large size, and commonly contains the stomach or the transverse colon, with a portion of the omentum, which form a tumor in the thoracic cavity, encroaching upon the lungs, and pushing the heart to one side. These herniæ are not enclosed in a peritoneal sac, but have been found partially enveloped by the pleura, and have, I believe, only been met with in the left side of the chest; the situation of the liver on the right side preventing their formation there. The following case, which occurred at the University College Hospital, affords a very good instance of this very rare affection.

Fig. 324.



A man seventy-four years of age was admitted into University College Hospital. About twelve months before, he fell into an area about ten feet deep, and believes that he injured his chest and head, as from that time he has suffered much from shortness of breath and occasional sensation of suffocation, has a hacking cough, and cannot lie down without feeling some difficulty in breathing. At the time of the accident he coughed up about three spoonfuls of blood. Ever since the accident he suffered much from dyspeptic symptoms and constipation, though before he met with the injury he had experienced no inconvenience in this respect. About a month ago the difficulty in breathing increased; and four days ago violent pain in the abdomen came on, and his bowels ceased to act, although he took a variety of aperient medicines and had enemata containing croton oil administered.

On admission the abdomen was found much distended, tense, and tympanitic, with pain around the umbilicus; the tongue was coated with whitish-brown, moist fur; the pulse was small, quick, and somewhat resisting; there was nausea, but no vomiting The skin was cool and the countenance anxious; the bowels had not acted for seven days, but he had frequent desire to go to stool. Ordered an aperient draught every third hour. As this had no effect, he was directed to take calomel and elaterium pills, and to have turpentine enemata, which afforded him some relief, though they brought away no fæces. The patient became more restless, the skin cold and flabby, the countenance more anxious, the breathing shorter, and the abdomen more tympanitic, and he died two days after admission, and nine from the commencement of the obstruction.

Examination of the body twenty-four hours after death.—The abdomen was distended and tympanitic, and the peritoneal sac contained about six ounces of fluid, with here and there patches of recently-effused lymph. The small intestines were not distended: the large were greatly distended with flatus, the cœcum extending into the cavity of the pelvis; the ascending and the transverse colon were much distended, and it was found that a large loop of the transverse and of the descending colon had passed through an opening in the cordiform tendon of the diaphragm into the pleural sac, and was there strangulated (fig. 324). The colon below the stricture was contracted, and entirely empty. On opening the thorax, the loop of intestine, fourteen inches in length, of a pale slate color, and distended with gas, was found in the left pleural sac. It reached as high as the fifth rib, touched the pericardium, and was overlapped by the free margin of the left lung. Where strangulated, it was of a darker color than elsewhere. The opening in the diaphragm, through which it had passed, admitted little more than the point of the forefinger, and had a thin tendinous margin. The tenth and eleventh ribs, on the left side, were found to have been fractured; the latter was united by osseous matter, but the tenth rib, at the seat of fracture, had formed a false joint. Connected with this and with the intercostal space below it, was a firm adhesion about an inch broad, and an inch and a half long, united by its other extremity in the protruded meso-colon and the diaphragm. The protruded meso-colon was firmly adherent to the upper surface of the diaphragm; close to the opening in it the lungs were tolerably healthy. The right pleura contained three ounces, and the left eight ounces of serum.

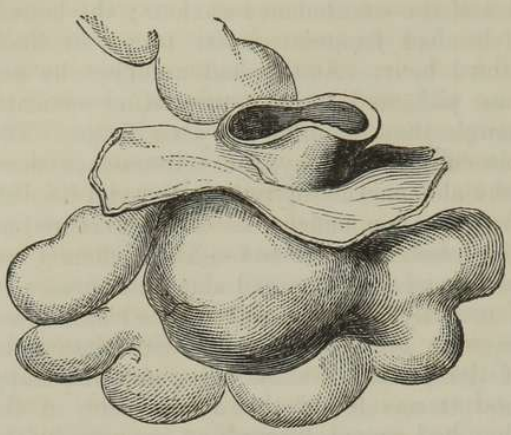
CHAPTER LIV.

INTESTINAL OBSTRUCTION.

Intestinal obstructions may be of two distinct kinds, the acute and the chronic, which should not be confounded with one another, as they are usually dependent upon very different conditions, and require different lines of treatment to be adopted for their relief. The acute intestinal obstruction may arise in various ways. When of a mechanical origin, it most commonly occurs in consequence of the formation of an internal hernia, which becomes suddenly strangulated, a portion of gut slipping through an aperture in the mesentery, or omentum (fig. 325), or becoming constricted by bands, adhesions, or diverticula, stretching across from one side of the abdomen to the other. In other cases, again, it may occur from invagination, the upper portion of the intestine slip-

ping into the lower, or by a portion of gut becoming twisted upon itself, and thus forming a volvulus, owing to the mesentery or meso-colon being unusually long, and allowing a half-twist to take place, in consequence of which complete obstruction occurs. In other instances, again, as Mr. Phillips has pointed out, the same train of symptoms may arise in consequence of a malignant stricture gradually closing and then at last becoming suddenly occluded. When the obstruction occurs by the formation of an internal hernia, the same changes take place in the constricted intestine that happen in ordinary ruptures, peritonitis supervening, and gangrene rapidly resulting. It is of much importance, however, in practice, to bear in mind that severe, and even fatal intestinal obstruction may occur, simply from spasmodic causes, or as the result of inflammatory affections of the abdomen, without the existence of any mechanical lesion.

Fig. 325.



The *symptoms of acute intestinal obstruction*, when arising from a mechanical cause, such as the formation of an internal hernia, or volvulus, are always characterized by a very marked vital depression. There is constipation, it is true, from the very first, but this symptom is not the most prominent one, and those that result are evidently, as in an ordinary case of strangulated hernia, the consequence of the injury inflicted upon the intestine, rather than of the mere mechanical obstacle to the onward passage of the fæces. At the moment of the occurrence of the attack, the patient is usually seized with a sudden feeling of something wrong having taken place in the abdomen; or he is struck with intense pain at one point. There may be sudden syncope, though most usually the depression of vital power does not amount to this. Vomiting speedily occurs; at first of the contents of the stomach, but after a time of a stercoraceous character; sometimes it assumes this form almost from the very first. The abdomen becomes swollen and tender, the intestines being blown up with flatus, so as to give rise to immense tympanitic distension, rolling over one another, and occasioning loud rumbling and gurgling noises. If the abdominal walls are thin, the rolling of the intestines may be distinctly felt, and in many cases seen through them; and may sometimes be observed to be continued up to one spot, where they cease. At this point an intumescence may sometimes be indistinctly felt, corresponding to the seat of strangulation. If relief be not afforded, the sufferings of the patient become very considerable, and his mental distress agonizing; the vomiting, perhaps, becomes less frequent, but the depression increases, and at last death results, usually about the sixth to the tenth day, though sometimes sooner from exhaustion, peritonitis, and gangrene conjoined, the mind being clear to the last, and the patient's attention being intently and distressingly rivetted upon the possibility of getting relief from the bowels.

Chronic intestinal obstruction usually arises from the gradual obliteration of the inferior portion of the large intestine, in consequence of the malignant degeneration of its walls,—from the compression of the gut by a tumor growing near it, — or from the obstruction of its cavity by the accumulation of large masses of hardened, feculent matters. The symptoms, in the earlier stages of these cases, are commonly those that will be described as indicating stricture of the large intestine; but when once complete obstruction has come on, the constipation becomes the most prominent symptom. There may be compara-

tively little constitutional disturbance at first, but the bowels cannot be made to act, and any attempt at forcing their operation by the administration of purgatives, gives rise to sickness and much distress. During the progress of the attack, eructations, retchings, and vomitings are of frequent occurrence, but it seldom happens that this is stercoraceous till the very last; there may be much tympanitis, with rumbling and gurgling of the intestines, but most frequently the abdomen fills slowly and gradually, and the symptoms do not occur until after some days have elapsed. In many instances life is prolonged for several weeks, for five or six, even after complete obstruction has set in; and in some cases recovery may take place even though a considerable time have elapsed from the occurrence of the obstruction. In a lady whom I attended some time ago, with Mr. Powell, recovery took place, although there had been complete obstruction for upwards of five weeks.

The *diagnosis* of the causes of the obstruction is of great importance; attention as to whether it assumes the acute or chronic form will throw some light upon the conditions that occasion it. It is often difficult to determine whether the obstruction is of a mechanical nature, or whether it depends upon a spasmodic or inflammatory affection of the intestine. The practice to be adopted in any particular case must at last be determined by a history of the symptoms, by a careful exploration of the abdomen and rectum, and by the light that can thus be thrown upon the question, as to whether the obstruction in that particular case be dependent on causes that are removable or not by medical means. In many instances, the history of the case, the assemblage of strongly-marked symptoms, and the result of abdominal and rectal exploration, enable the surgeon to determine, without much difficulty, that the obstruction is dependent on causes that are not removable by any means short of operative interference. But, in other cases, no means that we possess enable us to arrive at a correct, or even an approximate diagnosis. Cases are recorded that have ended fatally from obstruction in forty-eight hours, without sickness, fixed pain in the abdomen, or tympanitis. These cases, however, are certainly exceptional, and do not bear upon the question as to the propriety of performing gastrotomy in those instances in which it can be satisfactorily determined that a mechanical obstacle, not removable by medical means, exists. That the diagnosis may so far be effected with tolerable certainty is evident, from the fact that in all those cases of gastrotomy that have been of late years practised in this country, by Mr. Luke, Mr. Hilton, Mr. Avery, and myself, mechanical obstruction, irremovable by any but operative interference, was found.

1st. The most prominent symptoms, and those that will chiefly engage the surgeon's attention, are — α, the duration of the constipation; β, the occurrence of fixed local pain in the abdomen; and, γ, the character of the vomited matters.

α. *The duration of the constipation* does not throw much light upon the cause. Indeed if patients be naturally costive, constipation may last for a considerable number of days, or even weeks, without producing any very serious or fatal consequences. Most practitioners must have seen cases in which the constipation has continued for three or four weeks, without destroying the patient. Dr. Johnson mentions a case in which it lasted for forty-five days. In these cases, however, constipation has usually come on gradually, being, as it were, an aggravation of the patient's natural condition. In cases of acute internal strangulation, the constipation is always sudden, and is accompanied or speedily followed by other symptoms indicating intestinal obstruction.

β. *The occurrence of fixed pain* is common to many conditions of the abdomen; though, when taken in conjunction with the sudden supervention of obstruction to the onward passage of the fæces, with more or less tumefaction corresponding to the seat of pain, and more especially with the next symptom to which I shall advert, it is not without considerable value in the diagnosis of these cases.

γ *The Character of the Vomiting.*—When the obstruction is not dependent

on complete mechanical occlusion of the bowel, there may be incessant vomiting, and the stomach may reject its contents as often as anything is introduced into it; but the vomiting will not be feculent in the majority of cases, however obstinate the constipation may be, and however long it may last. If, however, there be complete mechanical occlusion, feculent vomiting most commonly sets in early, frequently by the third day, or even sooner; and will continue until the cause of occlusion be removed. The vomiting, however, is not continuous, but will usually only occur after food has been taken into the stomach. It is true that feculent vomiting is not sufficient, by itself, to determine the diagnosis; and that it may occur in cases of pure spasmodic ileus, in which the obstruction is removable by medical means. A remarkable case of this kind occurred a few years ago at the Westminster Hospital, under Dr. Basham, in the person of a black woman, who was admitted for hæmatemesis, with catamenial suppression. The stomach was very irritable, with occasional colicky pains in the abdomen for the first two weeks. The bowels, although torpid, were not completely occluded till within forty-eight hours of the stercoraceous vomiting. This latter condition continued for five weeks altogether, with an interval, in which the bowels acted; indeed, towards the latter period of the case, feculent vomiting occurred on the same day that a small alvine evacuation was obtained. She suffered during the greater part of this period from dysuria. There was also frequent spasmodic constriction of the rectum; and altogether much hysteria was mixed up with the symptoms. The stercoraceous vomiting gradually abated, the natural order of things returned, and she left the hospital sufficiently well to walk to Portsmouth in three days. It is therefore as necessary to bear in mind the occasional dependence of feculent vomiting on pure spasmodic ileus, or on other conditions that are removable by medical aid alone, as that it may be absent in cases in which the obstruction, whether seated in the small or in the large intestine, is not under the influence of medical treatment, and can only be relieved by surgical assistance. But I believe that a careful exploration of the abdomen and rectum, and a proper inquiry into the history of the case, will most generally prevent the surgeon from being led into any serious error by trusting too implicitly to the presence or absence of this one symptom.

2d. After determining whether the obstruction be dependent on causes that are removable or not, the next most important point is doubtless to ascertain whether the obstruction is seated in the large or in the small intestine. In general, there may be no great difficulty in coming to an accurate opinion on this point, if it be borne in mind that obstructions of the large intestines are most generally chronic, whilst those of the small are, in by far the majority of cases, acute in their character. The earlier occurrence of feculent vomiting when the obstruction is in the small intestine, the greater tympanitic distension and bulging in the course of the cœcum and colon when seated in the large intestine, — the amount of urinary secretion being, as was pointed out by Mr. Hilton and Dr. Bird, less in the former than in the latter case,—and the result of careful exploration of the rectum, will most commonly enable the surgeon to decide this question with sufficient precision to guide him in the choice of an operation. Yet, cases do occur, in which, though the obstruction be seated in the large intestine, — the symptoms are acute, and evidently not dependent on chronic obstructive disease, the vomiting of early occurrence, the distension of the abdomen slight, and in which exploration by the rectum yields no result; and it is in cases of this description, presenting a train of symptoms of mixed and uncertain character, that the diagnosis of the precise seat of the obstruction cannot be made.

The question as to whether the cavity of the peritoneum should be opened or not, will altogether turn, in any given case of intestinal obstruction, dependent on causes that cannot be removed without operative interference, on the

point, whether such obstructing cause implicates the bowel above or below the lower end of the descending colon.

α. When the obstruction is situated *below* the descending colon, exploration of the rectum will usually determine to what cause it is more immediately referable. Thus it may be owing to strangulation of internal piles, to compression of the rectum by an over-distended bladder, or to an enlarged uterus, engorged and tilted backwards so as to compress and constrict the rectum, and thus to lead to the supposition of the existence of tumor. If the intestinal obstruction be owing to one or the other of these causes, it may readily be relieved by appropriate treatment. It, however, more commonly proceeds from other conditions in this situation, that do not admit of relief except by operative interference; as from constriction, simple or malignant, of the upper portion of the rectum, or of the lower part of the sigmoid flexure of the colon, in consequence of the pressure of a pelvic tumor, or of a stricture from fibrous or cancerous degeneration of this part of the wall of the gut. Under these circumstances, the obstruction may be as complete as in a case of internal strangulation, and the patient will inevitably perish unless relieved by operation. But there is this important difference between the operative interference that may be called for by these obstructions that are situated below the descending colon, and those at a higher point in the intestinal canal:—that in the latter case the peritoneum must be opened; whilst in the former, relief may be given without interfering with the cavity of the peritoneum, by the operation of opening the descending colon in the left, or the cœcum in the right lumbar region, between the reflexions of the peritoneum at the part where the gut is not covered by that membrane.

β. When the obstruction is situated *above* the descending colon, it almost always occurs in the small intestine, rarely in the cœcum, or transverse colon, and may be dependent on various causes, some of which are removable, and others not, and of which preparations may be found in all the large pathological collections in London. Thus, it may be the result of internal strangulation, either occasioned by the small intestine falling into a pouch, formed by the meso-colon, or by the constriction of the gut by the passage across it of adventitious bands of fibres. It may be occasioned by intus-susception, by the lodgment of biliary or other similar concretions, or by mere spasm of the small intestine, which may be so persistent as to prove fatal. This is, doubtless, a rare occurrence; but cases of the kind are on record, in which the only post-mortem appearance that could be discovered has been a spasmodically contracted ileum. The great practical difficulty in all these cases of obstruction, above the sigmoid flexure of the colon, is to determine the cause of the obstruction, whether it is of such a nature as may be removed by operation or not. In some of the cases mentioned, there may be special symptoms, which lead to a tolerably correct diagnosis. Thus, in intus-susception, bloody or mucous stools may give a clue; in malignant or fibrous degeneration of the colon, the chronic nature of the disease, the history of the case, and the appearance of the patient, may indicate the nature of the obstructing cause

TREATMENT OF INTESTINAL OBSTRUCTION.

1st The *treatment of acute obstruction* must necessarily be in a great measure determined by the diagnosis that is made as to its cause. Before proceeding to the employment of any measures, whether medical or surgical, in these cases, the surgeon should, however, never omit to institute a careful examination of the various abdominal and pelvic apertures for some of the more obscure forms of external hernia; for in cases of supposed internal strangulation it has occasionally turned out, after death, that the patient had been laboring under a small femoral, obturator, or sciatic hernia. If such a condition be detected, it

must, of course, be relieved by proper operative means. In the event of no such protrusion being detected, and from the general obscurity of the symptoms in these cases rendering an exact diagnosis in the earlier stages almost impossible, it is generally expedient to try the effect of proper medical treatment, which will sometimes, even in apparently hopeless cases, afford relief. The only plan of treatment that appears to me of any value is an antiphlogistic one; the continued administration of calomel and opium, with the free application of leeches to the abdomen, followed by fomentations, will be of considerable service, and in some cases, even the most hopeless and complicated, will afford satisfactory results. In a very complicated case of intestinal obstruction which I attended with Dr. Garrod, this plan was eminently successful. A patient was admitted into the hospital under Dr. Garrod, having symptoms of internal strangulation; he had at the same time double inguinal hernia, and a small umbilical rupture, as well as the remains of a fatty tumor which had been partially removed from the abdominal wall many years previously. There was peritonitis with tympanitis, stercoraceous vomiting, and much depression of power, but as there was no strangulation existing about any of the external apertures, and as there was no evidence as to the precise locality of the internal mischief, it was not thought advisable to have recourse to operation. The patient was accordingly treated with calomel and opium, together with other antiphlogistic means, when, on the tenth day, the obstruction gave way and the bowels acted, the case ultimately doing well.

The *inflation* of the obstructed intestine, by the injection of air into the rectum, has been recommended in cases of intus-susception, and occasionally been practised with success. In the case of a young lady about ten years of age, to whom I was called into consultation with Drs. Murphy, Watson, and West, it was determined to do this on the fifth day after the setting in of symptoms of acute intestinal obstruction, apparently dependent on intus-susception. The inflation was followed by perfect success, the child feeling "as if a bone broke" in the abdomen, the obstruction being removed, and motions following in three hours, though all the previous treatment had been unavailing. For the convenient performance of this operation I have had an apparatus constructed, consisting of a circular double action bellows, with a long vulcanized India-rubber tube, furnished with a stop-cock and rectum tubes of different sizes for children and adults. When the air is thus pumped in, it is doubtful whether it passes beyond the ilio-cæcal valve, but this is of little consequence, in children especially, in whom the inflation of the large intestine alone may be quite sufficient, the obstruction often consisting of the slipping of a portion of the small intestine through this aperture.

If, however, for any of the various reasons that have already been mentioned, an internal strangulation of some kind be diagnosed, attended by urgent symptoms, and threatening the life of the patient, the great question to be determined is, whether it is advisable to have recourse to operative interference, and if so, when it is proper to undertake it? The solution of these questions is fraught with difficulty, and must always be a matter of the most anxious consideration to the surgeon. It is not only that he knows that if the patient is left unrelieved, he must necessarily die; but that he is aware that the only means of relief, gastrotomy, is probably nearly as fatal as the disease for which it is undertaken; no case in which this operation has hitherto been performed for internal strangulation having recovered. But the difficulties that present themselves in the solution of the question are much increased by the great obscurity in diagnosing the cause of the obstruction; for in many cases it is absolutely impossible to determine with certainty whether it be dependent on ileus, or arise from mechanical causes. If, however, by attention to any of the points that have been pretty fully adverted to, it can be satisfactorily made out that there is an internal strangulation, and more especially if the intumescence occasioned

by it can be felt, it would evidently be the duty of the surgeon to give the patient his only chance by the division of the stricture. With regard to the time at which this should be done, the only general rule that can be laid down is probably the conclusion arrived at by Mr. Phillips, that operation is justifiable when three or four days have passed, without any relief from ordinary means, constipation being complete, and vomiting of fæcal matters continuing.

Gastrotomy may be performed in the following way: — The room being well warmed, the patient should be laid on a high table, his legs being allowed to hang over the end of it, so as to afford a full view of the abdomen. The bladder having then been emptied, chloroform should be administered; and the surgeon, taking his stand between the legs of the patient, proceeds to make the incision through the abdominal wall. If a tumor can be felt, or the seat of obstruction in any way diagnosed, this must be made in a longitudinal manner directly over the seat of mischief; if there is no evidence to show where it is situated, it had best be made in the mesial line. It must be carried through the abdominal wall until the peritoneum is reached; this must then be slit up by means of a probe-pointed bistoury guided by the fore-finger of the left hand. The coils of intestine will now probably protrude through the wound, curling over its edges; they must be drawn to one side, and be carefully supported by an assistant, who should press upon them with a soft towel, whilst the surgeon goes in search of the obstruction. This he does by very carefully and gently tracing upwards the contracted and empty coils, which must necessarily be below the seat of obstruction, or following downwards the distended intestine. If there be a hernial constriction, he may divide the band that constitutes the stricture by means of the scalpel, or break it through with the finger, or withdraw from the aperture in the omentum or mesentery into which it had slipped, the constricted coil of intestine. If it be a case of volvulus, the gut may be untwisted, as in a case on which I operated. The intestines having been returned, the wound should be closed by the interrupted suture, and the application of some transverse strips of plaster; the patient must then have his knees bent over a pillow, and should be kept principally upon ice and barley-water. Opium must also be administered, and the case generally treated on the ordinary principles of abdominal wound.

2d. The *treatment of chronic intestinal obstruction* must be conducted upon different principles. Here the great point is to remove the constipation. With this view the rectum should be explored, and if found to be blocked up by impacted fæces, as may sometimes happen, these must be removed, and copious enemata administered. At the same time purgatives may have a trial given them, and a drop or two of croton-oil may be exhibited. If the constipation, however, arise from mechanical causes, this means will usually considerably increase the patient's distress, and then it should not be repeated; but the patient should be kept quiet in bed, have a nourishing diet, but one that leaves little residue, administered, and the passage opened by enemata, and the introduction of the tube of a stomach-pump. If these means do not succeed, and if the obstruction, as is almost always the case in these chronic instances, be seated in or below the sigmoid flexure of the colon, the intestine must be opened at a point above the seat of disease. This may be required for acute as well as chronic obstruction; for it may be observed, that, although in the acute form, the obstacle is usually situated in the small intestine, yet it is occasionally met with in the colon. But in chronic obstruction it is always the large intestine that is affected. The operation required to give exit to the intestinal contents is of two kinds; in one the intestine is opened in the left iliac fossa, by cutting through the peritoneum covering it. In the other it is opened in the left loin by cutting between the layers of the meso-colon, and thus opening it where it is uncovered by peritoneum.

The first operation — or Littre's, as it has been called — was proposed by a

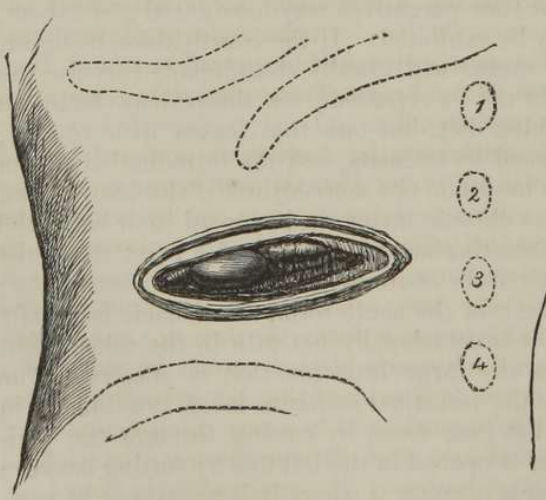
surgeon of that name, in 1710, who advised that in these cases the sigmoid flexure of the colon should be opened from the left iliac region; but it was not until the year 1776 that any operation of the kind was performed; when Pillore, a surgeon of Rouen, was the first to make an artificial anus on the adult, for relief of retention of fæces: this he did, not according to Littre's method, but by opening the cœcum from the right iliac region. Fine, of Geneva, in 1797, opened the transverse colon from the umbilical region, in a case of retention of fæces produced by scirrhus of the upper part of the rectum.

Although these operations serve to fulfil the indication of relieving the retention of the fæces, they are all defective in one most important respect, for, as the peritoneum must in all of them of necessity be wounded, an intense and frequently fatal peritonitis is the inevitable consequence. It was to avoid this serious complication that Callisen, in 1796, proposed opening the colon from behind, in the left lumbar region, where it is not covered by peritoneum. He once attempted this operation on the dead body of a child, but failing in his endeavor to reach the intestine without wounding the serous membrane, he seems to have relinquished all further idea of it; and it was subsequently rejected as impracticable by all those writers on surgery who have treated of this subject.

Amussat, at the time that he was attending the celebrated Broussais for that scirrhous affection of the rectum of which he ultimately died, was led to reflect on the resources which surgery offers in similar cases; and, after making some experiments on the dead body, with the view of contrasting the merit of the different operations that have been proposed for the formation of artificial anus in cases of obstruction of the large intestines, he became convinced that the operation proposed by Callisen, if somewhat modified, was not only practicable, but safe. He soon had an opportunity of putting this opinion to the test of experiment in 1839, and since this the operation has been performed forty-four times.

The following is the way in which Amussat's operation may be performed: A transverse incision is to be made two fingers' breadth above and parallel to the crista ilii of the left side, or rather in the middle of that space which is bounded by the false ribs above and by the crista ilii below; the incision should commence at the external margin of the erector spinæ, and extend outwards for about four inches. The spinous processes of the lumbar vertebræ, the crista of the ilium, and the last false rib, are the principal guides. The superior margin of the crista ilii is, however, the safest of these, and the transverse incision may be said to correspond to the middle third of this part of the ilium. After having divided the skin and the more superficial tissues, the muscular layers are next to be incised as they present themselves; if necessary, the external border of the quadratus lumborum may also be cut across. The dissection is then very carefully to be carried through the dense layers of cellulo-adipose tissue, which lie immediately upon the intestine and the colon sought for; this will, in general, readily present itself, and may at once be recognized by its greenish color and distended appearance (fig. 326).

Fig. 326.



The operation may then be completed by passing a tenaculum, or needle armed with a strong waxed thread, into the most projecting part of the gut; and, by this means, drawing it to the surface of the wound, in order to prevent it shrinking or sinking back when opened. It is now to be punctured with a large trochar or bistoury, and its contents having been evacuated, the sides of the opening in the intestine are to be fixed to those of the incision in the skin by four or five points of suture, so as to prevent the contents of the bowel being effused into the cellular tissue of the wound (fig. 327). It is of importance to draw the colon well forwards before opening it, in order to prevent its contents from being effused into the loose cellular tissue of the wound, where they may set up considerable irritation and retard the union of the parts. If the patient be very fat, the operation is proportionately difficult, on account of the depth of cellulo-adipose tissues lying in front of the quadratus, and which requires to be very carefully dissected through before the gut can be reached. This step of the operation will be much facilitated by dividing the deeper-seated tissues in a crucial manner, so as to give the operator more space. When the operation is practised on the dead body, it will be found on dissection that the following are the parts cut through: After the skin and cellular tissue, the latissimus dorsi will be seen divided towards the posterior third of the incision, and the obliquus externus in the anterior two-thirds of it; the obliquus internus and the transversalis, sometimes the quadratus lumborum, the cellulo-adipose tissue which immediately covers the intestine, and finally the colon itself. The colon will usually be found a little in front of a point that lies midway between the anterior and posterior spines of the ilium. After the more superficial incisions have been made, the surest guide to it will be the line of condensed fascia which forms the anterior edge of the sheath of the quadratus, and which lies between that muscle and the transversalis. This line may always readily be distinguished by its buff color from the surrounding muscular structures. Very few vessels or nerves are wounded, as they for the most part run parallel to the line of incision; whereas if the vertical incision of Callisen were adopted, they would necessarily be cut across.

Fig. 327.

Amussat's operation may also be called for in cases of cancer of the rectum, when there is perhaps but little or no distension of the gut, the object being to prevent the fæces passing over and irritating the ulcerated surface; in such cases as these the operation is very difficult in execution; for on account of the contracted state of the colon, that intestine recedes behind the quadratus lumborum, and the folds of peritoneum nearly surround or invest it, and it is so covered in by fat and cellular tissue that a very cautious dissection is required to expose it without wounding the peritoneum.

When we compare the different operations that have been proposed for the formation of an artificial anus, it will be found that Callisen's, as modified by Amussat, is the one to which the preference must be given, for by it alone the peritoneum is not wounded, and thus the inflammation of that membrane, which is a necessary and so often a fatal consequence of the other operations, is avoided. Beside this advantage, which is of the very greatest importance, Amussat's operation presents several other claims to our notice. As only one side of the colon can be drawn forwards, and not a knuckle of it, as would be the case if the small intestines were operated upon, it is evident that the spar-like process which has been described by Dupuytren, must exist to a very small extent; and consequently, if the artificial anus should ever become useless, the natural passage for the fæces having been re-established, it could readily be closed up. If, however, the peritoneum should be accidentally wounded in the attempt to reach the colon from behind, even then this operation would be preferable to

that of Littre; for the cavity of the abdomen having been opened at its most depending part (in the recumbent position), the fæcal matters would have much less tendency to be effused into it, than if it were opened in front. In respect of not wounding the peritoneum, this operation closely resembles that of puncturing the bladder above the pubes, and below the reflection of that membrane. There is, however, one important difference between the two operations, which may influence the result; for in the one case as the patient lies upon his back the urine has a tendency to stagnate in the wound, being obliged, in order to escape, to mount against its own gravity; whilst in the other case, the fæcal matters find a ready exit from a wound situated in a depending part.

Mr. Cæsar Hawkins, in a most interesting and valuable paper, published in the 25th volume of the "Medico-Chirurgical Transactions," has collected and analyzed 44 cases, in which an artificial anus has been formed by opening the intestine; in 17 of these the artificial anus was made through the peritoneum, and in 27 behind that membrane; but for various reasons, which are stated at length in the paper, Mr. Hawkins excludes 5 of the cases of peritoneal section, leaving only 12 to compare with the 26 cases of operation behind this membrane. Of the former, he finds that 7 died and 5 recovered; the recoveries amounting therefore to only forty-one per cent. in the cases of this category, whilst of the 26 cases where the peritoneum was uninjured, 10 died and 16 recovered; the proportion of recoveries in the cases of this category amounting to sixty-one per cent. Though the large intestine was *opened in all these cases*, the operation was performed on the *right* side in 10 instances; in 4 cases the right colon and cœcum were opened through the peritoneum, and of these all died; whilst in the remaining 6, in which the right colon was opened behind the peritoneum, 4 recovered. The preference, therefore, as Mr. Hawkins observes, on the right side, is certainly due to the lumbar operation. It is remarkable, however, that in the operation on the *left* colon, the results are somewhat different; for of 8 cases in which this intestine was opened through the peritoneum, 5 recovered and 3 died; whilst of 20 cases in which the lumbar operation was performed, 11 recovered and 9 died. Mr. Hawkins observes, that the inequalities of the numbers appear, however, to leave the question as to the mode of operating on the descending colon, still undecided, and that an operator is justified in selecting whichever situation he thinks best for the formation of an artificial anus on the left side of the body; though, for the reasons that have already been given, I should prefer Amussat's to Littre's operation. In those cases in which death has resulted from Amussat's operation, peritonitis does not appear to have exercised any material influence, and the fatal result seems rather to have depended on the influence of previous disease on the constitution of the patient, or on changes taking place in the bowels, than on the operation itself, which appears occasionally to have been uselessly done at the last extremity. We should, therefore, have less hesitation in performing the extra-peritoneal operation in an early stage of those cases in which it is called for, than we should if the section itself were attended with any serious risk to the patient's life.

CHAPTER LV.

DISEASES OF THE LARGE INTESTINE AND ANUS.

CONGENITAL MALFORMATIONS

Of the anus and rectum are by no means of unfrequent occurrence, and are of considerable importance; for, if unrelieved, they must necessarily be the cause of speedily fatal intestinal obstruction. They may exist in various degrees, which I think may most conveniently be arranged under the following heads:—

1st. *Narrowing of the anus* so as partially to close it, the canal continuing pervious, but not sufficiently so as to allow of the bowels being completely emptied, the contraction usually merely admitting a full-sized probe; in some cases appearing to depend upon constriction of the anal orifice, in others upon an imperfect septum stretching across it. The treatment of this variety consists in notching the contracted anus with a probe-pointed bistoury, and then introducing a sponge tent, so as to dilate it to the proper size, to which it must be kept by the occasional introduction of a bougie.

2d. The anus may be *completely closed* by a membranous septum stretching across it, usually having a raphe along the central line, and a slight depression, through which the dark meconium can be seen, and on which an impulse can be felt. In this variety an incision must be made through the septum along the middle line, and this again cut across on either side, when the meconium will freely escape. The four angles that are left must now be removed, and the aperture kept open by the introduction of a well-oiled plug. This constitutes perhaps the most common form of malformation that is met with.

3d. The *anus may remain open*, but, at a distance of about half an inch or an inch from its aperture, the rectum will be found occluded by a perfect membranous septum, stretching across it. This is a rare and somewhat puzzling kind of malformation, as in it the infant will be found to labor under intestinal obstruction, and yet, on examination, the anal orifice will be found perfectly formed, and thus the surgeon might be misled as to the seat of the obstacle. He will, however, detect it by introducing a probe or the end of his little finger into the anus. In two cases of this kind which have been brought to me, I have opened the septum by puncturing it with a large trochar, and, after the lapse of a few days, dilated the aperture by means of a sheathed bistoury, the cases ultimately doing well.

4th. The anus may be *completely absent*, being blocked up by a dense mass of fibro-cellular structure, from half-an-inch to an inch in thickness, above which the rectum terminates in a kind of *cul-de-sac*. In such a case as this, an incision about an inch in length should be carefully made, from the point of the coccyx forwards, and the dissection carried down until the gut is reached; this must then be punctured, and the meconium allowed to escape. If the cut surface is left to granulate, with a plug of lint merely interposed between its sides, it will gradually contract, and degenerate into a fistulous opening, through which the meconium will escape with difficulty, and as this track is not lined by a mucous membrane, the probability is that the irritation set up along it by the intestinal matters will ultimately prove fatal to the child. Indeed, it commonly happens in these cases that death results in a few days from irritation occasioned by the absorption of the excreted fluids. In order to obviate this source of danger, Amussat thought of bringing down the mucous membrane of

the bowel to the anal orifice, and of fixing it there by sutures, so as to afford the meconium a mucous canal to pass through, and thus to prevent the diffuse inflammation which is apt to take place in the cellular tissue of the pelvis, by the contact and absorption of the effused matters. In many cases it is by no means easy to do this, but yet it should always be attempted, as I believe the whole safety of the child depends upon this being carried out. For some considerable time after the operation, the aperture should be kept dilated by means of bougies; a gum-elastic or pewter tube, through which the fæces are allowed to escape, may be fixed in the part.

5th. The anus may be *closed*, and the whole of the *rectum absent*, the intestine (colon) terminating in an expanded pouch, situated high up at the brim of the pelvis. Such cases as these only differ from the last in the extent of the occlusion, and cannot indeed be distinguished from it until the surgeon has made an incision in the site of the anus, and has failed to reach the gut at the usual distance from the surface. In these cases the dissection requires to be carried with caution to a considerable depth along the mesial line, the surgeon taking the curve of the sacrum and coccyx for his guide, and bearing in mind the relations of the bladder and large vessels in the neighborhood, carefully proceeding in search of the gut, which may be found at a considerable depth from the surface. In three instances of this kind on which I have operated, it was necessary to proceed to a depth of at least one and a half or two inches before the bowel was reached, which, on account of the narrowness of the wound and the small size and important relations of the parts, is not an easy matter. An attempt may be made to bring down and fix the gut at the external orifice, as in the last case, but, on account of the distance that it is from the surface, this can rarely be expected to succeed. As the perineal section seldom succeeds in saving life in these cases, it might be a question whether the descending colon should not be opened in the iliac or lumbar regions.

In these cases three courses present themselves to the surgeon. 1st. The colon may be opened in the left iliac region; 2d. It may be reached in the left lumbar region; and, 3d. An opening may be made into it through the perineum.

The only advantage that the iliac incision, or Littre's operation presents, is that it is an operation easy of performance, and that whether the surgeon reaches the colon or not, he is certain to hit upon some part of the intestinal tube which may be drawn forwards and opened.

The objections to this operation are, the inconvenient situation of the artificial anus; the great danger that must necessarily result from wounding the peritoneum; the chance of not finding the sigmoid flexure; and, as has often happened, of being obliged to open that portion of the small intestine which first presents itself.

The mortality after this operation is very great. Amussat states, that of twenty-one children thus operated on, only four ultimately recovered; and it is worthy of remark, that all the successful cases occurred in the town of Brest.

The lumbar incision, or Amussat's operation, has not as yet, to my knowledge, been successfully practised on an imperforate child.

The advantages of this operation consist not only in the artificial anus being situated at a more convenient spot than in Littre's operation, but more especially in the possibility of opening the colon in this situation without wounding the peritoneum.

The objections to this operation, as applied to imperforate children, lie in the frequent co-existence of malformation or malposition of the colon, with absence of the rectum, and in the impossibility in many cases of determining, before proceeding to operate, whether the anus is only occluded by a membranous septum, or whether the rectum is absent as well. If it could be ascertained beforehand that, though the rectum be absent, the descending colon occupies its normal position in the left lumbar region, I think it probable that the lumbar

incision would be attended with less danger than any other operation that could be practised; but in the absence of this knowledge, it would scarcely appear to be justifiable to have recourse to it, as the colon might not be found, and the anus might merely be covered by a dense membranous septum.

The perineal incision has the advantage of being in the natural situation of the anus, and of being easily practised and perfectly successful in all those cases in which the anus only is imperforate, the rectum being present. It is in those cases only in which there is congenital absence of the rectum that this operation is difficult of performance, and uncertain in its results. If it could be ascertained, before proceeding to operate, that the rectum be absent it might be wiser to search for the bowel in the lumbar region. But as the surgeon has no means of ascertaining, before making his incision, whether the rectum be one inch or three inches from the surface, he must cut into the perineum in order to obtain the necessary information; and if once he has penetrated to such a depth as to get beyond the levator ani muscle, or into the deep fasciæ in this situation, a great portion of the immediate danger of the operation will have been incurred, and few would think it advisable to leave the perineal operation unfinished, and expose the child to the additional risk of opening the colon in the lumbar region.

There is one point in connection with the perineal operation to which it is of much importance especially to attend, not only as respects the immediate result of the operation, but as regards the ultimate success of the procedure, I mean the bringing down of the mucous membrane of the gut, and fixing it to the lips of the external wound. Unless this be done, the line of incision between the termination of the gut and the aperture in the integuments will degenerate into a fistulous canal, which, like all fistulæ, will have a tendency to contract, and will be a source of endless embarrassment to the surgeon and to the patient. If the mucous membrane can be brought down and fixed to the opening in the integument, this source of inconvenience will be removed, and the patient will be saved all that danger which results from the passage of the meconium over a surface of recently incised cellular tissue. This, however, can only be done when the intestine terminates at a short distance from the surface. If the perineal incision be two or three inches in depth, there would be little probability of the surgeon being able to bring the intestine down to such an extent. In the case that I have related I attempted to do so, but found that the gut was too firmly fixed to be moved by any traction that it would have been safe to have employed.

6th. The anal orifice may be *absent*, and the gut *may open into one of the neighboring mucous canals*, as the vagina, the urethra, or into the bladder. In such anomalous cases as these there is usually, I believe, but little to be done, except to restore the anal orifice, and then to take the chance of the other preternatural communication closing. This it will sometimes do, and cases have occurred in which, although the whole of the meconium with flatus had escaped per urethram, yet on opening the rectum the abnormal communication seemed gradually to close, the fæces being directed into their proper channel. In a case in which I was recently consulted, there was imperforate anus and rectum, and the bowel protruded as a red, fleshy tube, about four inches in length, from the end of which in the anterior abdominal wall, just below the umbilicus, and immediately above an extroverted bladder, the meconium escaped. In such a complicated malformation surgery could evidently do nothing.

STRICTURE OF THE LARGE INTESTINE.

Stricture may occur in any part of the rectum or colon, and is of two kinds, the *simple*, consisting of mere thickening of the bowel, with fibrous degenera-

tion of its coats and contraction of its canal; and the *malignant*, dependent on cancerous degeneration of, or formations in the bowel.

The *simple* or *fibrous stricture*, though occasionally occurring in the transverse or descending colon, is most frequently met with at the junction of the sigmoid flexure and the rectum, or at the upper part of this gut, from four to six inches from the anus. Not unfrequently a very tight annular stricture is found in otherwise healthy subjects, chiefly in young women, at the lower part of the rectum, about an inch and a half from the anal orifice, appearing almost as if it were the remains of a septum, or a thickened annular fold of the mucous membrane in this situation.

Stricture of the large intestine commonly occurs in elderly people, and with special frequency in women; that form which occurs low down I have however frequently seen in young women, otherwise perfectly healthy.

The *symptoms* of stricture of the rectum consist at first of some difficulty in defecation, the patient being obliged to strain at stool. The fæces will also appear to be flattened or narrowed, and in many cases, more especially as the stricture advances, are passed in the form of small scybala, with occasionally a kind of spurious diarrhea, consisting of the passage of the more fluid intestinal contents, whilst the solid matters are left behind. At the same time there is very commonly pain in defecation and the occasional passage of some mucus or blood, and dyspeptic symptoms, with flatulent distension of the abdomen are apt to come on. If the stricture is within four or five inches of the anus, it may be reached with the finger, and its precise situation and diameter ascertained. If above this point, it must be examined by the introduction of a well-greased bougie, attention being paid to the curve which the rectum makes from side to side, as well as from before backwards. In introducing bougies in order to ascertain the presence of a stricture above the upper end of the rectum, but little information can be gained in many cases, as the point of the instrument is apt to hitch in folds of the mucous membrane, or opposite the promontory of the sacrum, and thus its onward passage being prevented, an appearance of constriction may present itself, which in reality does not occur, and unless care be taken the mucous membrane may actually be lacerated, and the instrument forced through it into the peritoneal cavity. In other cases again the bougie will appear to pass, when in reality its point meeting with an obstruction curves downwards into the rectum.

The progress and termination of a simple stricture vary in different cases. In some the contraction of the stricture may go on increasing, until at last complete occlusion takes place, with retention of fæces and all the symptoms of obstructed bowels. This condition usually comes on slowly, and after the obstruction is complete, life may continue for several weeks; but in some instances the obstruction appears to take place rather suddenly, and with all the symptoms of acute intestinal strangulation, with death in a few days. Abscess occasionally forms in the neighborhood of the stricture, and passing down into the pelvis may either burst into the ischio-rectal space, into the vagina, or present upon the nates. The discharge of pus from this source, as well as from the mucous membrane lining the stricture which falls into an ulcerated state, may induce extreme emaciation and hectic, to which the impairment of nutrition consequent upon the disturbance of digestion adds materially. In some cases peritonitis will at least ensue, either in consequence of ulcer or abscess communicating with the serous cavity, or else from the extension of the irritation outwards.

The *treatment* of simple stricture of the rectum must be conducted on the principle of dilating the canal at its constricted point. If this be within reach of the finger, the dilatation can be readily carried out. If it is above the upper part of the rectum, and the stricture be tight, it is extremely difficult to introduce the proper instruments with certainty. When the stricture is low down,

so that the end of the finger can be introduced into it, it may readily be dilated by introducing a rectum bougie every second day, and gradually increasing the size of the instrument. If the stricture yields but slowly, and is very tight and indurated, I have found it a convenient plan to introduce a sheathed probe-pointed bistoury into it and to notch it towards its posterior aspect, where this may be done without danger to the peritoneum. A tent of compressed sponge should then be introduced and left in for twelve hours. On its withdrawal bougies may more readily be passed, or the dilatation may be carried on by means of tents of compressed sponge. When the stricture is above the reach of the finger a good deal of management will be required to get the bougie into it. This is best done by laying the patient on his left side and using a moderate-sized wax or elastic bougie, which must be passed without the employment of any force. When once the surgeon has got one through, others can readily be got to follow in the same track. The great danger in introducing the bougies high up is to mistake the obstruction offered by their point coming in contact with one of the valvular folds of mucous membrane, that occur in this situation, for that of the stricture, and pushing on the instrument to perforate it — an accident that would probably occasion fatal peritonitis. During the introduction of bougies, the bowels must be kept regular by means of lenitive electuary and the occasional use of emollient enemata. If much pain or irritation should be occasioned by their presence, opium should be administered internally or in the form of suppositories. Though a simple stricture of the rectum may be much relieved by the use of bougies, it is seldom I think cured by this means, there being a great tendency for it to contract so soon as the treatment is discontinued.

If complete obstruction occur, an endeavor should be made to relieve the patient by the use of enemata of gruel and linseed-oil, and the strength should be supported by a diet that is nourishing, at the same time that it leaves little or no solid residue; the bowels may eventually act after a considerable lapse of time, the stricture apparently giving way. In a case which I attended with Mr. Powell, and to which reference has already been made, the stricture gave way after obstruction had lasted for about five weeks, some hardened fæces with bloody mucus being discharged, which were speedily followed by abundant feculent motions. Should the obstruction, however, continue, and the patient consequently be in imminent danger of death from this cause, the intestine should be opened if possible by Amussat's operation, performed in the way already described (p. 820). This may require to be done either on the right or left side, according to the seat of stricture. In the majority of instances this will be situated below the descending colon, so that relief may be given by opening this intestine in the left loin; but if it is impossible, or even very difficult to determine the precise seat of the obstruction, the operation may as readily be performed in the right lumbar region. In those rare cases in which the stricture is seated in the transverse colon, there would probably be considerable distension of the right loin, without any corresponding enlargement of the left; under these circumstances, the proper plan would be to open the cœcum.

CANCER AND MALIGNANT STRICTURE OF THE RECTUM.

Cancer of the rectum usually occurs in the form of degeneration or infiltration of the substance of the wall of the gut, giving rise to considerable induration and contraction of the bowel. In other cases a flat cauliflower growth springs from the inner surface of the intestine, being hard, nodulated, and presenting all the ordinary characters of scirrhus. And sometimes even this is somewhat pedunculated, so as to resemble a hemorrhoidal protrusion: and lastly a scir-

rhous tumor may form in the cellular tissue external to the rectum, and at last press upon and implicate the gut.

Most usually cancerous disease is seated from three to five inches above the anus, and may implicate a considerable portion of the bowel, extending upwards rather than downwards, and giving rise to considerable induration and contraction, with complete occlusion of the interior of the gut.

The *symptoms* of cancer of the rectum are pain and weight in the gut, with a sensation as if the bowels had not been completely relieved, together with the discharge of mucus, blood, or pus, and some flattening of the fæces. On exploring the parts with the finger, the lower portion of the rectum will usually be found considerably expanded, whilst the tip of the finger will come in contact with the contracted, hardened, and rugged scirrhous mass. The patient experiences most suffering during defecation, in consequence of the passage of fæces over the raw and ulcerated surface. This pain is not confined merely to the diseased part, where the sensation is of a hot and burning character, but usually radiates round the loins and down the thighs, and is so severe, that the patient looks forward to each action of the bowels with the greatest possible dread, and restrains it as long as possible. The whole nervous system at last participates in this continually recurring suffering, the countenance becomes anxious, the spirits depressed, sleep and digestion destroyed. The patient's condition is indeed truly miserable between the dread of excessive suffering when the bowels act, on the one hand, and the fear of impending obstruction on the other, and in many instances he is worn out by this suffering, together with the constitutional cachexy induced by the contamination of the system with the cancerous matters. Not unfrequently the misery is much increased by the formation of fistulous openings in the neighborhood of the bowel, and communications between it and neighboring parts, such as the vagina, bladder, or urethra, with cancerous implication of them. In other instances, though more rarely, death occurs from fæcal obstruction, as in the case of simple stricture.

The *treatment* must necessarily be of a palliative kind; large doses of opium being required after each action of the bowels to lessen the patient's distress. Little good can be expected from more active measures; dilatation only irritates the disease, and would tend to increase the mischief. The application of caustics, such as potassa fusa, does not offer much prospect of advantage, as only a superficial slough could in this way be formed, without very serious risk to the patient, and it is an excessively painful remedy. Amussat has proposed to crush and break down the morbid mass by means of the finger and forceps; but from such treatment as this little good can be anticipated. The recommendation to excise the cancerous mass, as made by Lisfranc and other French surgeons, is contrary to every principle of good surgery, as it is impossible to extirpate the whole of the disease, without either laying open the peritoneal cavity, or destroying the patient by the profuse hemorrhage which could scarcely be arrested. If palliative means fail in affording the requisite relief, and the patient suffers much local pain and constitutional irritation during defecation, the propriety of establishing an artificial anus in the left lumbar region might be discussed, not with a view of saving life, but rather in the hope of prolonging existence, and lessening suffering by preventing the exhaustion and agonizing pain that attend the passage of the feculent matter over the ulcerated surface (p. 821). In several instances much relief of suffering and considerable prolongation of life has been effected by this procedure.

Polypi sometimes form in the rectum, constituting large pendulous tumors of a fibro-mucous character; they may most conveniently and safely be removed by the application of a ligature to their neck.

DISEASES OF THE ANUS.

Cancer of the anus is not a very common affection, and when met with usually occurs in consequence of scirrhus of the rectum spreading to and involving the margin of the anus. When it occurs as a primary disease it is usually of an epithelial character, and may then form about the anus just as it does at other muco-cutaneous apertures. If limited and detected in the early stage it might advantageously be excised, but at a more advanced period of the disease, such a practice could scarcely be adopted with any prospect of success, in consequence of the impossibility of removing the whole of the structures implicated.

Ulcer and fissure of the anus.—This disease, though trivial in point of size and in its pathological relations, is of great practical importance on account of the excessive local pain, and great constitutional irritation to which a patient laboring under it is often subject. Ulcer and fissure commonly exist together in this situation, though it by no means unfrequently happens that the two conditions occur separately; the ulcer is usually of small size, seldom larger than a silver threepence, of a circular or a longitudinal shape, situated between the folds of the mucous membrane in the upper part of the anus, or rather the lower part of the rectum, just above the ring formed by the sphincter, and is usually met with towards the posterior part of the gut on one side of, or opposite to, the point of the coccyx. Occasionally more than one ulcer exists in this situation. If a fissure accompanies the ulcer, it commonly leads from this across the face of the sphincter to the verge of the anus; but in many cases one or two fissures, sometimes even three or four exist, without any ulcer. The fissures are usually slightly indurated and cord-like, and not unfrequently their external termination is concealed by a small pile or flap of integument.

The existence of the ulcer may usually be determined by exploring the rectum with the finger, which if practised in these examinations, will detect a small, soft, and velvety patch at the diseased spot; on touching which the patient will usually complain of acute and burning pain. In some cases the ulcer may be brought into view by examining the rectum with the speculum ani, such as here delineated (figs. 328 *a* and 329). The fissures may always readily be detected

Fig. 328.

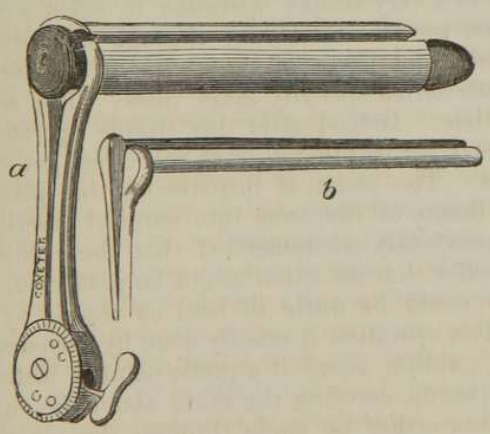
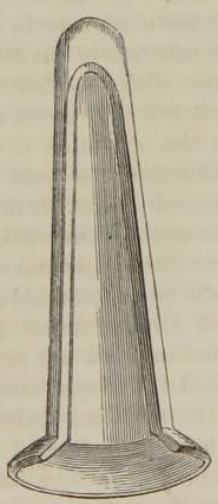


Fig. 329.



by everting the mucous membrane of the anus, and by lifting up or turning aside the pile that covers the lower end of the crack. During this examination

it will usually be found that the sphincter ani is in a more or less spasmodically contracted state, admitting the finger and instrument with difficulty.

The *symptoms* of ulcer or fissure in the anus are very characteristic. The patient complains of pain usually of a severe burning character on the passage of a motion, especially if a hard one, especially at the time of defecation, but more frequently commencing a few minutes afterwards and continuing for from half an hour to several hours. This pain is very severe and peculiarly wearing and burning; it is generally most felt, opposite the sacro-iliac articulation, but not unfrequently radiates round the pelvis or down the thighs. In many cases it produces a good deal of continued irritation about the genito-urinary organs, giving rise to symptoms of spasmodic stricture; a frequent desire to urinate, tenderness about the prostate, and seminal emissions. Very commonly in women, the pains produced by the rectal disease simulate those occasioned by uterine irritation; and, in both sexes, they may after a time become continuous, and be attended by a good deal of constant uneasiness in sitting, so that the patient is obliged to raise the affected hip. There is often a discharge of a streak of pus or blood on the fæces, and commonly a good deal of mucous exudation, with some tenesmus on defecation; but in some instances these symptoms are altogether absent, and the patient never suffers any local inconvenience except from the pain.

The constitutional irritation is often very great, the nervous system generally sympathizing with the local mischief. The countenance becomes pale, anxious, careworn, and the expression is indicative of constant suffering.

This affection most commonly occurs in women, especially in those of an hysterical temperament and weakly constitution. When met with in men, it is most frequently seen in enfeebled, cachectic, and debilitated subjects, and appears to be the result of a broken state of health.

The *treatment* of fissures or ulcers of the anus, when the disease is met with in the early stages, may sometimes be successfully conducted by the application of nitrate of silver to the fissure, and the use of an anodyne or astringent suppository I have found a very excellent and useful suppository in this and many other painful affections of the anus to be composed of 2 grains of extract of belladonna, 2 grains of the acetate of lead, and 4 of tannin, made up to a proper consistence with a little suet. This may be introduced into the rectum every night and allowed to dissolve there; the bowels should at the same time be kept gently open with castor-oil, or the lenitive electuary. In those cases in which the disease has been of some standing these means will not suffice, and it becomes necessary to have recourse to a very simple operation to effect a cure. This consists in dividing the affected mucous membrane through the ulcer or fissure, with possibly some of the subjacent fibres of the sphincter muscle, by which the part is set at rest and cicatrization speedily takes place. The relief after the operation is usually immediate. Indeed after this simple operation a patient who has been suffering severely for months or years will often get complete and almost instantaneous relief. The merit of introducing this plan of treatment for the cure of ulcer and fissure of the anus into surgical practice is due to Sir B. Brodie. Boyer had previously recommended that the sphincter should be cut completely across in order that its action might be paralyzed, but Sir B. Brodie found that the ulcer could be made to heal as readily by the limited incision above mentioned. The operation is readily done by introducing the left fore-finger into the rectum, guiding along it a probe-pointed bistoury, and then cutting downwards and outwards, carrying the knife about the eighth of an inch in depth. The section may either be made through the ulcer and fissure, or on either side of the coccyx. It is doubtless better, when practicable, to cut through the diseased structures, though it is not necessary to do so; and it is always better to make an incision on both sides of the sphincter, so as to be sure that the muscle is set at rest. No dressing is required after this operation,

but if the incision do not readily heal at the end of a fortnight or three weeks, it should be touched from the bottom with the nitrate of silver. The patient's bowels should be well opened before the operation, and a dose of castor-oil may be given on the second or third day after it. During the process of cicatrization it will often be advantageous to give iron, and to put the patient on a very nourishing diet.

Spasmodic contraction of the sphincter ani is usually associated with fissure or ulcer of the anus, but occasionally it occurs without this complication, and in all cases it may be connected with a neuralgic condition of the part. In hysterical women this neuralgia and spasm are especially apt to occur, though it is not improbable that in many of the so-called cases of neuralgia of the anus, some positive disease, such as a small ulcer or fissure, may be detected on close examination, as I have had several occasions to verify. The treatment of spasm of the sphincter, whether associated with neuralgia or not, consists in the employment of local sedatives, enemata, and laxatives, with, if necessary, the division of a few of the muscular fibres, together with the mucous membrane.

Abscess not unfrequently occurs in the vicinity of the rectum and anus. It may either be superficial, being confined to the muco-cutaneous structures, and presenting the ordinary characters of acute subcutaneous abscess, or it may be deeply seated, forming in the ischio-rectal fossa. It is these rectal abscesses that are of most practical importance. The may be of two kinds — *acute* and *chronic*.

The *acute* ischio-rectal abscess forms deeply in the fossa, with throbbing, shooting, and stabbing pains through the anus, rectum, and perineum; on examination, a hard brawny substance may be felt in the cellular tissues by the side of the gut, either by examination from without, or by exploration through the rectum, which speedily softens, and will, unless an outlet be made for it, either burst externally, or into the cavity of the gut, or both ways. This acute form of abscess usually occurs in persons of otherwise strong and healthy constitutions.

The *chronic* ischio-rectal abscess, on the other hand, occurs insidiously in persons of cachectic, broken, or phthisical constitutions, and without much pain or local inconvenience will form a large collection, denuding the gut to a considerable extent, in fact, almost surrounding the rectum, and then spreading widely on the nates or hip, presenting all the ordinary characters of a chronic abscess. This kind of purulent collection may form in this as in any other situation in the body, as the result of congestion, or some local irritation. But there is reason to believe that in some instances at least, it occurs as the result of perforation of the gut, either by ulceration from within, or by some foreign body, as a fish-bone, for instance, transfixing it, and thus inducing inflammatory action in the cellular tissue outside the rectum.

In the *treatment* of these abscesses the principal point to be attended to is to prevent the extensive denudation of the gut. In order to do this they must be opened, so soon as the formation of pus can be ascertained to have taken place, by making a free, and if necessary, a deep incision into the ischio-rectal space by the side of the bowel. Unless this be done, they may either burst into the interior of the gut, or spread widely upon the nates, and then give way. The pus that is let out of these collections is always extremely offensive even though not mixed with any feculent matter, the near neighborhood of the bowel appearing to determine some change in it that renders its smell peculiarly stercoraceous. After the evacuation of the abscess the patient feels easy, and thinks that all is well, the discharge gradually lessening and the cavity contracting; but it does not close, and a fistula will be left, which continues to exude a thin watery pus, in which feculent matter, perhaps, accumulates from time to time, giving rise to fresh outbreaks and extensions of the disease.

FISTULA IN ANO.

The sinus left by the contraction of the cavity of an ischio-rectal abscess constitutes a *fistula in ano;* an affection that has attracted a good deal of attention from the frequency of its occurrence, and the difficulty of curing it without having recourse to operation.

Fistula in ano may vary as to extent and kind. Some fistulæ are very limited, being merely the sinus left in the submucous cellular tissue of the anus after the bursting of a superficial abscess in this situation, extending to a short distance up the gut inside the sphincter. This form of fistula constitutes, however, a kind of spurious variety of the disease, for the true fistula in ano is outside the sphincter in the surrounding cellular tissue, extending always as high as the upper margin of that muscle, and frequently stretching to a considerable distance up the side of the gut. Most frequently the lower aperture of the fistula is somewhere in the perineum or ischio-rectal fossa, just beyond the sphincter; but not unfrequently sinuses extend from this outwards to a considerable distance, undermining the integuments about the buttocks, stretching away towards the trochanters, and opening at a great distance from the bowel. These extensive fistulæ and sinuses are frequently connected with stricture of the gut.

Fistula in ano varies also as to kind. It is said to be *complete* when it communicates by one end with the interior of the rectum, and opens by the other upon the external surface. It is said to be *incomplete* when it has only one aperture, whether that is external or internal.

The *complete* fistula is the most common, and probably arises in the majority of cases from some source of irritation seated within the bowel, by which the mucous membrane of the rectum has been perforated, and an abscess has formed in the cellular tissue outside the gut. The external opening in this form of fistula is usually from half an inch to an inch from the margin of the anus, though it may be seated at a greater distance than this, as upon the hip. It is commonly of small size, and has a vascular granulation projecting from, or occluding it; and a thin purulent discharge usually drains away from it in small quantities, moistening the surrounding integuments. The internal opening is usually situated just above the sphincter, where the rectum begins to expand. But the fistula does not terminate at this internal aperture, for in the majority of cases it runs up into a kind of cul-de-sac, to a considerable distance further. The internal aperture may readily be detected by introducing a blunt curved probe into the fistula, when by a little management it may be carried through the inner opening. In some cases the existence of this may be ascertained by examining the interior of the bowel with a speculum ani.

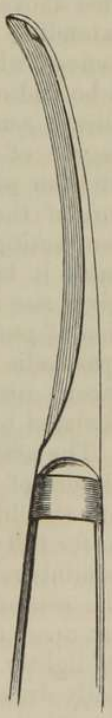
The *incomplete* or *blind* fistula may be of two kinds, and commonly arises from constitutional causes. When there is no internal perforation, a mere sinus having been left by the bursting of an abscess, the fistula is termed *blind external.* When there is only an internal aperture it is called *blind internal.* The blind external fistula is readily recognized by its being found that the probe does not penetrate the interior of the gut. The blind internal is not so readily detected, but in this case it will generally be found that the patient suffers from an occasional and tolerably abundant discharge of pus from the interior of the bowel; that there is a good deal of tenderness, with some brawny induration on one side of the anus; and that the pus may be made to well out in some quantity by pressing upon this part. On passing the finger into the rectum the ragged internal aperture in the gut may readily be felt through which the pus exudes.

In the *treatment* of fistula in ano, operative interference is usually necessary. It is true that in some rare instances the canal may be got to close under the influence of constitutional management, aided perhaps by stimulating its inte-

rior with the nitrate of silver, or by touching it with a probe dipped in nitric acid. This kind of treatment is however only successful in the blind external fistula, several instances of which I have seen get well in this way, but it can never be expected to answer in any other variety of the disease. When the fistula is complete, the only plan of treatment that offers any chance of success, is the division of the sphincter, so that this muscle which tends to prevent the closure of the sinus, may be paralyzed, and the fistula being laid open from the bottom, made to heal by granulation. Various plans have been devised for the division of the sphincter, and much ingenuity has been expended in attempts to discover simpler and less painful modes of effecting this than by the knife, but hitherto without success, and the only plan of treatment that deserves any attention is the division of the sphincter with a curved bistoury.

The *operation* for fistula in ano should not be performed indiscriminately in all cases and at all periods of the disease. If the fistula be dependent upon stricture of the gut, and more especially if this be of a malignant character, it is evident that no operation can be attended by a chance of success, and none should be attempted. So also if the patient be cachectic and broken in health, it is well to improve his constitutional powers before undertaking an operation, lest the wound that results may not readily cicatrize. It is also well to wait until the disease has assumed a somewhat chronic form before proceeding to the division of the sphincter; if this be done early after the bursting of the abscess, or at any time if there be much inflammatory action going on, the wound is apt to assume a somewhat sloughy condition, and to heal with great difficulty. The most important question usually connected with the operation for fistula, is the propriety of performing it in phthisical subjects. It is a well-known fact that fistula in ano is especially apt to occur in consumptive individuals, and it is often a nice point to determine whether an operation should be performed or not in them; — how far the drain from the fistula may keep up or even generate the tendency to phthisis, or how far it may be salutary in acting as a counter-irritant, and in preventing the morbid condition of the lung developing itself. Dr. Theophilus Thompson states that the co-existence of fistula with phthisis appears to retard the progress of the latter disease, acting as a derivative, and doubtless in some instances this may be so. I have, however, in several cases found considerable advantage result by operating for fistula in the early stages of phthisis, or in suspected cases of that disease, the patient's health having considerably improved after the healing of the fistula. In such cases it may be of use to put an issue in the arm or side of the chest. But in confirmed, and still less in advanced phthisis, no operation should ever be practised, as the wound will not heal, and the patient must be weakened by the additional discharge.

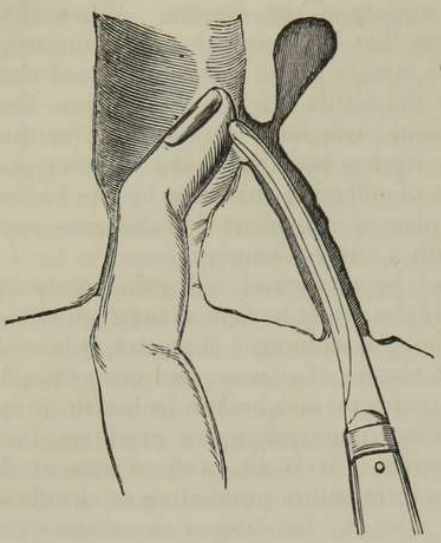
Fig. 330



The operation should be performed in the following way: — The bowels having been well cleared out the day before with a dose of castor-oil, and an enema administered on the morning of the operation, the patient should be laid on his left side, with the nates projecting over the edge of the bed; a probe must then be passed through the fistulous track into the rectum, and the surgeon introducing the forefinger into the gut, feels for the end of the instrument, he then passes a short strong-bladed probe-pointed bistoury, about the size and shape of that represented in the adjoining figure (330), through the fistula, using the probe as a guide, though in some cases this may conveniently be dispensed with. When he feels the end of the knife projecting into the rectum, through the internal aperture of the fistula, he withdraws the probe, hooks his forefinger over it (fig. 331), and by a sweeping and pressing cut, raising the handle of the instrument

at the same time that he pushes down its point, brings both finger and blade out at the anal aperture, cutting through the whole thickness of parts between this and the fistula, so as to lay the two cavities into one. In performing this operation, the surgeon must cut with his left hand if the fistula be upon the left side; and in either case should be careful not to wound his own finger, as such cuts often prove troublesome in healing. If sinuses stretch from the fistula along the nates or hip, he may, if he pleases, slit these up with a probe-pointed bistoury, before dividing the sphincter. But if they be extensive, such an operation may be of a somewhat serious character, and it will then be better to make a puncture into the sinus near the external margin of the anus, and divide this structure in the usual way. If the fistula be a blind external one, it must at the time of the operation be made complete, by scratching with the end of the knife through the thinned structures that intervene between its extremity and the interior of the gut; and the operation must then be completed in the way described. If it be a blind internal fistula, a puncture must be made through the integuments into the canal, with a sharp-pointed bistoury, and the operation then concluded in the ordinary way.

Fig. 331.



When there is an internal aperture into the gut, this will usually be found just above the sphincter; but the fistula does not terminate here, frequently extending up by the side of the gut for an inch or two. Under these circumstances, what should be done with the cul-de-sac above the inner aperture? If it be laid open, an extensive and deep wound will be inflicted, which may implicate some of the hemorrhoidal vessels, and thus give rise to a dangerous degree of bleeding. Hence, surgeons generally content themselves with the division of the sphincter and all the parts intervening between the inner aperture of the fistula and the verge of the anus; the sinus which is left usually contracting and closing without difficulty when this has been done. In some cases it happens, however, that this cul-de-sac is not readily obliterated, but gives rise to a good deal of trouble, in consequence of the occasional accumulation of pus in it, and the thickening of its aperture into the bowel giving rise to spasmodic contraction of the sphincter and a kind of rectal stricture. This inconvenience gradually subsides in most cases; should it continue, it may be obviated by introducing a sheathed bistoury into the track and dividing it.

The after-treatment should be as simple as possible, consistently with securing closure of the wound by granulation from the bottom. A narrow slip of oiled lint should be introduced between the lips of the wound, and this must be left in for forty-eight hours, during which time the bowels are kept confined by the administration of a grain or two of opium immediately after the operation. On the second day a dose of castor-oil may be administered, which will not only act upon the bowels, but bring away the piece of lint. The wound must then be lightly dressed from the bottom, a poultice applied, and care taken at the daily dressing, by the introduction of a probe, to prevent the bridging over of granulations. After the wound has completely united, a notch will usually be left by the side of the anus, which gives rise to some inconvenience for a time by the occasional involuntary discharge of a little intestinal mucus, and some flatus. This especially happens in those cases in which the incision has been

made anterior to the anus into the perineum, and when incontinence of fæces may, for a time, be left. Should the operation be followed by abundant hemorrhage of a dangerous character, the rectum must be securely plugged, either with compressed sponge or with a bougie surrounded by lint.

HEMORRHOIDS, OR PILES.

By hemorrhoids or piles, is meant a morbid condition of the blood-vessels of the anus and lower part of the rectum, more especially of the veins of the submucous and subcutaneous cellular tissue, giving rise to more or less intumescence of the part, which may or may not be attended with a discharge of blood. Surgeons are commonly in the habit of classifying piles, according as they bleed or not, into *open* or *blind;* or according as they are situated above or below the verge of the anus, into *internal* or *external;* the internal being always within the gut, the external habitually protruding out of or around the anal aperture. The first may either bleed or not; the latter are always blind. To this division into external and internal, Mr. B. Cooper has added an intermediate variety, the intero-external, which is partly within and partly without the anus. These divisions are of much practical moment, as the treatment is very materially modified according as the hemorrhoid is situated above or below the anal verge.

We must look to the peculiar arrangement of the veins of the rectum as directly predisposing to the occurrence of piles. The lower part of the rectum and the verge of the anus are composed of a plane of muscular fibre and a muco-cutaneous surface, with an intervening stratum of dense cellular tissue. In this cellular membrane is situated a close interlacement of net-work of tortuous veins. The blood from this plexus of hemorrhoidal veins, finds its way into the general system through two distinct channels. By far the greatest portion of it is carried into the inferior mesenteric vein and thence into the vena porta through the medium of the superior hemorrhoidal vein, which may be looked upon as the extreme radicle of the portal system; and secondly, a certain quantity passes into the internal iliac vein through branches that accompany the middle hemorrhoidal artery. We may therefore look upon the hemorrhoidal plexus as being placed midway between the portal and general venous systems, being the point indeed at which they touch; but as belonging rather to the portal than to the systemic veins. In these arrangements we see all the elements that would predispose to congestion, and consequent dilatation of the vessels of a part. There is a large and intricate plexus of veins in which, as in all similar net-works, there is a tendency for the blood to circulate slowly at times; the natural tendency to stasis of the blood being much increased by the dependent position of the part, and by the anatomical fact that in consequence of the absence of valves in the superior hemorrhoidal vein and in the vessels into which it pours its contents, the whole pressure of the column of blood in the portal system may be brought to bear upon the hemorrhoidal plexus. The circulation through the portal system is likewise subject to much interference in consequence of hepatic and intestinal obstruction, and in these changes the blood in the hemorrhoidal plexus also participates; and were it not for the provision that exists by which this plexus may free itself to a certain extent from over-distension by its communication with the internal iliac through the medium of the middle hemorrhoidal vein, piles would be much more frequent than they even now are, as a consequence of obstructed portal circulation. Another great cause of hemorrhoidal enlargement is to be found in the want of support that the veins of this plexus experience on their mucous aspect during defecation. Situated as they are in cellular tissue, between a plane of muscular fibres on one side, and yielding mucous membrane on the other, when distended by the constriction which they undergo during and after the expulsion

of the contents of the rectum, they necessarily give way on that side on which they have the least support, being forced down and elongated, together with the mucous membrane under which they ramify, and which has a natural tendency to become slightly everted during the act of defecation. It will be found that all the more immediate or exciting causes of piles act by unduly increasing one or other of those natural tendencies that exist in the system, by favoring the local congestion or determination of blood at the same time that they produce a lax state of fibre.

Age exercises considerable influence in predisposing to piles. This disease is not unfrequently met with in young men of eighteen or twenty years of age, more especially if they be of a relaxed and phlegmatic temperament with languid circulation, and are obliged to lead a more sedentary life than is natural or proper at that age. After this period the liability to the disease diminishes until middle age is reached, when the tendency to hemorrhoidal affections is again increased, and becomes more marked than at any former period of life, owing to the more active operation of those causes that tend to impede the return of the portal blood.

Sex appears to exercise more influence on the occurrence of hemorrhoids at particular periods of life, than on the general liability to the disease. It certainly appears to be more frequently met with amongst men at an early age, than in young women; but at a later period of life, so far as my observation goes, the disease occurs with nearly equal frequency in both sexes. The comparative exemption of young women is readily accounted for by the periodic discharges from the uterus preventing the congestions that might otherwise occur in the parts in its vicinity. The greater frequency at a later period of life is attributable not only to the tendency induced during pregnancy by the pressure of the gravid uterus, but also, after the cessation of the menses, to the determination that is apt to be set up in certain organs of the female economy, and to the retardation of the portal circulation by the accumulation of fat and other causes; these conditions chiefly occur in women of a sanguine and plethoric habit of body.

A sedentary life with indolent habits constitutes, perhaps, the most powerful predisposing cause of the disease; more especially if habitual high living is conjoined with want of proper and sufficient exercise. Indeed the artificial and luxurious habits of the more opulent classes, by diminishing tone at the same time that they occasion plethora and a tendency to abdominal engorgement, exercise a considerable influence on the occurrence of this disease, which is much more frequent amongst them than in persons in the humbler walks in life.

There are a number of minor conditions which are commonly looked upon as predisposing causes of this disease, though it is extremely difficult to determine the precise share that each has in its occurrence. Amongst these may be mentioned intemperance in food and drink; residence in warm, moist, and relaxing climates; the use of soft and warm beds; or, the opposite condition of sitting on a cold stone or damp cushion. Over-excitement of the generative organs will also occasion it.

Amongst the exciting causes may be mentioned local irritation of any kind. Thus in some people hard riding will bring on an attack of piles. The habitual use of drastic purgatives, more especially of aloes, rhubarb, &c., is well known to occasion the disease; though it must be observed that individuals who make habitual use of these remedies, often labor under some of those obstructions of the abdominal viscera that have already been noticed as conducing to piles. The existence of other diseases about the rectum and anus, such as fistula, ulcer or stricture, by inducing local congestion and irritation, may excite the disease; so also uterine affections and various diseases of the genito-urinary organs may give rise to this affection.

The most direct exciting cause of piles is certainly a retardation to the return of the portal blood. Any impediment to the onward current of the blood through the hemorrhoidal or mesenteric veins, the trunk or ramifications of the vena porta, exercises a marked influence on the tendency to congestion of the hemorrhoidal plexus. Habitual constipation; the accumulation of hardened feculent masses in the large intestine; the want of due secretion from the mucous surface; obstruction to the proper action of the liver, and consequent congestion of that organ; the pressure of abdominal tumors, or of the gravid uterus, are all active exciting causes, interfering as they do with the proper return of the portal blood. In some cases even the existence of an obstacle in the systemic veins may occasion this disease; thus it will arise from the pressure of an aneurismal tumor on some of the larger venous trunks within the chest.

Structure of piles.—A pile, whether external or internal, consists essentially, in the first instance, of a varicose condition of a portion of the hemorrhoidal plexus, or, rather, of the small veins of the submucous tissue that pour their contents into this; this varicose condition becoming prominently developed at certain points, gives rise to small knots or tumors. A pile, in this state, is quite soft and compressible, and can readily be emptied by pressure, and when cut into, will be found to be composed of one or more cells filled with blood, and surrounded by areolar tissue. The appearance of cells is, however, deceptive, and is occasioned by a section of the sacculated and dilated veins that enter into the composition of the tumor. After the piles have existed for some little time, or after they have once become inflamed, the tissues that enter into their composition undergo modifications that induce corresponding alterations in the character of the tumor. The coats of the veins become thickened, their cellular dilatations are filled with coagulated blood, the investing areolar tissue is hypertrophied or thickened by plastic deposit, and on being cut into, the pile is seen to be composed of a spongy kind of tissue filled with blood. External piles, when examined after removal, often resemble in structure a mass of hypertrophied cellular tissue, infiltrated with plastic matter, in which a number of small vessels of uniform character ramify, but without any appearance of cells. Internal piles, on the contrary, contain more of the venous, and less of the cellular element. They are also commonly furnished with a small central artery, which is apt to bleed freely, or even dangerously, if the tumor is cut across; hence, provided they are not clogged with coagulated blood, they may readily be injected from the inferior mesenteric artery.

In studying the structure of hemorrhoids, it is of importance to observe that they occur under two different forms: one in which there are distinct tumors, within or external to the anus, and the other in which there is merely a varicose condition of the veins of this region, without distinct intumescence.

In those cases in which there is merely a general varicose state of the veins of the submucous cellular tissue of the anus, without any distinct tumor springing above the level of the membrane, it will be found that the smaller branches of the hemorrhoidal plexus, and the small twigs that enter these from the submucous cellular tissue, have undergone varicose dilatation, being apparently greatly increased in number, as well as in size. The mucous membrane is of a deep mulberry, or port-wine color, and becomes everted after each motion. There is usually some mucous secretion about the anus, rendering the part moist: and the patient complains at times of weight and of bearing down, with pains either in the part itself, the sacro-lumbar region, or the thighs. The motions, more especially if hard, are streaked with blood, and more or less of this fluid drops in a rapid manner after the passage of the fæces. There is seldom much blood lost, but at times there is an exacerbation of all these symptoms, and the hemorrhage, as will more particularly be mentioned hereafter, may become very abundant. This condition of the mucous membrane may precede,

and is frequently found to accompany the true pile, whether external or internal, and may be looked upon as constituting the first stage of this disease. If this state of things is allowed to continue unrelieved, the tendency to congestion increases; more and more of the mucous membrane becomes everted and protruded after defecation; the submucous cellular tissue becomes stretched and lax, and the case is apt to become one of prolapsus ani.

External hemorrhoids are those that are situated below the verge of the anus, and that are invested by cutaneous, or, at most, by muco-cutaneous tissue. Before appearing as defined tumors, they usually constitute longitudinal folds that surround the anal aperture, or radiate from it as from a centre. In color, they vary from that of the natural structures to a pink or purplish hue, and their tegumentary covering consisting of the thin skin of the part, they resemble folds of this tissue rather than of mucous membrane. Their size varies, according to the state of congestion, and, hence, the same tumor may at one time be soft, flaccid, and loose, apparently nothing more than a fold of integument, and at another may become tense, tumid, and ready to burst. When of small size and recent formation, they do not in general give rise to much distress, merely some local heat, pricking, and itching, with a sense of fulness after defecation; but when of large size, and inflamed or irritated, they may occasion very acute suffering. There is not only deep-seated, dull, aching and throbbing pain in the pile itself, but this shoots up the side of the rectum, through the perineum, and into the nates, and is much increased when the patient stands or walks. After a few days these symptoms subside; suppuration either taking place in the pile, or the blood contained in it coagulating. The parts are, however, left in a thickened and indurated state, and do not readily resume their former soft and flaccid condition, effusion of plastic matter taking place into the cellular tissue, and the contained blood perhaps coagulating, so that the tumor can no longer be emptied by pressure, assuming the form of a broad, rounded or indurated mass.

Internal piles. — When the pile is situated altogether within the verge of the anus it is called internal; of these there are two principal varieties, the *longitudinal* and the *globular*.

The *longitudinal*, or as it is sometimes called, the fleshy pile, is generally met with about an inch or two up the rectum. It is spongy, elastic, firm, or tough, of a dark reddish, or dusky brown tint, tapering upwards from a broad base. It seldom bleeds or varies much in size; between these piles are found small curtains, valves, or folds of mucous membrane, forming sacculi, or pouches, with their convexities looking upwards. These sacculi are apt to become distended and pressed downwards by the fæces, more especially if the motions are hard and the bowels have been constipated, thus giving rise to a tendency to prolapsus.

When the hemorrhoid assumes a *globular* form it constitutes the ordinary bleeding pile. It may be situated on a broad base, or, as not unfrequently happens, its point of attachment to the mucous membrane becoming elongated it assumes a pedunculated shape, hanging downwards into the cavity of the rectum. It is of a dark bluish color, and numerous small vessels of a brighter hue than the body of the pile may be seen ramifying on the mucous membrane investing it. Its surface is at first smooth and shining, and may continue so throughout, being covered with a thin and delicate prolongation of the lining membrane of the gut. Not unfrequently, however, superficial ulceration takes place, and then it has a granulated strawberry-like appearance.

Internal piles are usually attended by a sensation of heat, itching, pricking, or smarting about the anus, and a feeling as if there were a foreign body within the gut. After defecation these sensations are increased and are often accompanied by a bearing down, as if the bowel was not emptied of its contents, that is peculiarly distressing and sickening. This is occasioned by the piles or the

elongated and condensed mucous membrane to which they are attached, protruded during the expulsion of the fæces, and not returning sufficiently quickly, being grasped by the sphincter ani and constricted by it. This feeling of discomfort and bearing down is much increased if the patient stand or walk much after having had a stool, or by a confined state of the bowels. If this state of things is not properly attended to, the symptoms become increased in severity, the bearing down sensation amounts to true tenesmus, and the act of defecation becomes so painful that the patient defers it as long as possible, and then when it does take place, in consequence of the accumulated excreta and their indurated character, the suffering is much increased. Internal piles now usually make their appearance if they have not existed before, the mucous membrane of the rectum becomes prolapsed, and an increase secretion of thin mucus takes place from the orifice of the gut, moistening the part and soiling the patient's linen. Irritation in neighboring organs is frequently set up, and occasionally to so great an extent as to mask the original complaint, the patient referring his principal pain and discomfort to these sympathetic disturbances. There is often a dull aching fixed pain at the lower part of the lumbar spine, and more frequently opposite the sacrum or the sacro-iliac articulations on either side; this is sometimes very severe, perhaps down the thigh, or round the groins; irritability of the testicles may come on, or irritation about the neck of the bladder, causing the frequent desire to micturate, and increasing the patient's sufferings by the straining that takes place. The general health now suffers, the patient may become emaciated, and the countenance often presents a peculiarly anxious, drawn, and care-worn look.

The symptom, however, that first of all, and most prominently fixes the patient's attention is hemorrhage. This varies greatly in quantity; at first it may merely consist of a few drops falling after the passage of a motion, or the cylinder of fæces may be stained on one side by a streak or spots of blood, or it may amount to several ounces or even pints.

When moderate in quantity it often affords relief to the other local symptoms, and seldom proves injurious from the quantity lost at one time, but if profuse and occurring at short intervals, its effects on the constitution may be alarming.

The *hemorrhoidal flux* is connected with, and in the great majority of cases dependent upon, the existence of distinct hemorrhoidal tumors. Occasionally, however, it appears to occur when there is no distinct separate tumor projecting above the surface of the membrane; but in these cases there is general intumescence and congestion of the whole of the mucous membrane of the lower part of the rectum, from which the blood exudes in drops.

It is frequently ushered in by an exacerbation of those symptoms that commonly accompany piles, such as a sensation of fulness, weight and tension about the parts. But the symptoms that precede its occurrence are often much more imperfectly marked than is usually stated, and are frequently absent altogether.

The flux may be periodical, occurring every month, or at intervals of two, three, or six months, remittent or intermittent; when once it has set in, it usually continues from three to six days, increasing in quantity up to the third or fourth day, and then lessening.

When moderate in quantity and short in duration, it is often a source of relief to the patient; but if a very large quantity be lost at one time, or if it continue for too long a period, more harm is usually done to the patient by its long continuance than by its excessive quantity at any one time. The patient may become much debilitated; nervous headaches, pallor, palpitations, syncope may result. In some cases, it has been said, that this discharge is of service, acting as a derivative, and preventing diseases falling on more important parts; it has especially been looked upon, and, doubtless is in many cases a safeguard

from apoplexy and visceral congestions and obstructions, more particularly when occurring in plethoric and corpulent persons who habitually live too high. In other cases it may be considered as critical, more especially when occurring about the cessation of the menstrual period.

The color of the blood most generally is florid, as if it came from the small arteries or capillaries of the part rather than the veins. It would appear, as if in consequence of the over-distended and varicose condition of the veins of the part, the onward flow through the arteries and capillaries leading to them was obstructed, and that in consequence of the accumulated pressure on these vessels their parietes gave way, allowing the florid blood to escape from the veins.

Very commonly the internal piles when brought down, present a somewhat granular surface, in consequence of ulceration having taken place, and the whole surface will be seen to exude blood in drops. In other instances again, the blood appears to come from a cavity in one side of the hemorrhoid, as if rupture had occurred from over-distension at that part. Occasionally, however, the flow of blood is so rapid and copious that it could not be supposed to come from exudation, but would appear to depend on rupture of the vessels of the part.

The hemorrhoidal flux may be accompanied by, or alternate with a thin glairy mucous discharge from the rectum and diseased structures; this would appear to be nothing more than hyper-secretion of the membrane, in consequence of the irritation set up by the pressure of the piles; it is seldom in sufficient quantity to produce much annoyance, or to be of much moment to the patient.

Piles are not uncommonly complicated with other diseases of the rectum, such as fissures, fistula, or prolapsus; when connected with fissure, the hemorrhoid often, as Mr. Syme has remarked, assumes a peculiar form and appearance, presenting itself as a small red-colored body, like a pea in size, firm, and seated at the base of the fissure, which it often conceals; to a practised eye, however, the presence of a pile of this peculiar color and shape is sufficient to indicate the existence of the fissure.

In that form of fistula in which the aperture is near the anus, one or more external piles of small size are often found situated at the orifice of the fistula, and prolapsus rarely, if ever, is met with in adults, without the simultaneous occurrence of piles.

Terminations. — Hemorrhoidal tumors may terminate by *subsidence*, *coagulation*, *suppuration*, and *sphacelus*. Complete subsidence of the pile can only take place when the disease is of recent occurrence. When of long standing, and after it has been exposed to successive attacks of inflammation and turgescence, it never subsides completely, and the cellular tissue and muco-cutaneous structures becoming hypertrophied, form elongated pendulous flaps around the margin of the anus.

Coagulation of the contents of the pile is the result of inflammation having taken place in it, and probably terminating in plastic effusion, by which the vessels leading from it are obstructed. When it takes place, the tumor, after more or less active inflammation, becomes hard, incompressible, and indolent, permanent in size, and of a purplish or plum-color. The coagulum thus formed may remain persistent, may excite suppuration, or may be absorbed, the hypertrophied tissues forming one of the usual anal folds. In some rare instances the coagula may become converted into structures resembling phlebolites.

Coagulation more frequently takes place in external than in internal piles, owing to the great impediment in the return of the blood from them, and to their greater liability to inflammation, their exposed situation leading them to be bruised or otherwise injured; when it occurs in internal piles, it most com-

monly affects those that are of a columnar or longitudinal shape, and least frequently the globular variety.

Suppuration is not an uncommon termination, if acute inflammation have been set up in external piles, more especially in those that have previously been coagulated; when the abscess is discharged, small coagula escape with its contents, the cavity granulates, and becoming obliterated, the pile is cured.

In some rare cases, when there is much elongation of the mucous membrane from which the pile springs, prolapsus of that membrane and of the piles may take place, which being grasped after it has descended by the contraction of the sphincter, the same effect may be produced as if a ligature were applied; the tumor becomes much swollen, hard, livid, and tense, there is much constitutional disturbance and restlessness, but after a few days all the symptoms are relieved by the part that is constricted sloughing and dropping off.

The *diagnosis* must be regarded in two points of view:—1st, as concerns the hemorrhoidal tumors; and, 2d, with reference to the hemorrhoidal flux.

Hemorrhoidal tumors must be diagnosed from prolapsus ani, polypus of the rectum, and condylomata about the anus.

From prolapsus, the diagnosis is not always easy; indeed, the two diseases are so generally associated, that it is of little moment to attempt it.

In true prolapsus, ocular examination will suffice to distinguish the membranous wall of the intestine, forming a smooth, rounded, and somewhat lobulated annular protuberance, from the isolated tumors of piles. In polypus, the history of the case, the pedunculated and solitary character of the tumor, its large size, and comparatively slight tendency to periodical hemorrhage, will enable the surgeon to make the diagnosis. From condylomata the diagnosis is easy; the soft, flat, mucous, and wart-like character of these growths, their history, and their occurrence at other points, as the perineum, scrotum, vulva, and buttocks, will enable the surgeon to distinguish them without any difficulty.

The hemorrhoidal flux must be distinguished from other intestinal hemorrhages. This may be done by attention to the character of the blood, which will enable us in many cases to determine its source. When from piles it is liquid, of a more or less florid color, and not unfrequently is quite bright, staining or coating the fæces rather than being mixed up with them. When, on the contrary, the blood is poured out at some higher point in the intestinal canal than the usual seat of hemorrhoids, it is of a dark sooty character, mixed up with liquid fæces either in a diffused form, or in small black coagula, and no fresh or bright blood will be visible. Digital exploration of the rectum in cases of piles, and the presence of symptoms indicating the existence of mischief at a higher part of the intestine than the anus in cases of melæna, will also serve to point to the seat of the flux.

Treatment of Piles.—In conducting the treatment of a case of piles, that surgeon will succeed best who looks upon the disease not as a local affection, merely requiring manual interference, but as a symptom, or rather an effect, of remote visceral obstruction and disease, the removal of which may alone be sufficient to accomplish its cure, without the necessity of any local interference; or should it be thought necessary to have recourse to operative procedure, that this must be made secondary to the removal of those conditions that have primarily occasioned the congestion and dilatation of the hemorrhoidal vessels. The treatment of piles, therefore, must be considered, 1st, as regards the removal of those constitutional conditions or visceral obstructions that occasion the disease, together with any topical applications that may be considered necessary; and, 2d, with reference to the operative procedures that may be required for the removal of the affection.

1st. The constitutional management of piles necessarily varies considerably, according to the condition of the patient in which they occur, and the visceral obstruction to which they may be referable. Thus, when occurring in debili-

tated persons, apparently from relaxation of the vessels, most benefit will be derived by a mild tonic and nutritious plan, at the same time that the bowels are kept regular by some of the aperients that will immediately be mentioned. In these cases, also, much advantage is often obtained by the administration of the confection of black pepper, which acts as a useful local stimulant to the vessels of the rectum. In the great majority of instances, however, more particularly when occurring about the middle period of life, piles are connected with a plethoric state of system, and obstruction of the abdominal viscera. Under these circumstances, our efforts should be directed to the reduction of the plethoric condition, by putting the patient upon a proper regimen, prohibiting the use of stimulants, and lessening the quantity of animal food that he is in the habit of taking. When the piles arise from the pressure of a gravid uterus, or other abdominal tumor, little can be done, except, by local palliatives and mild aperients, to moderate the inconvenience attending them.

In all cases of piles, but more particularly in those arising from hepatic obstruction, mild aperients are of essential service; by removing feculent accumulations, and establishing a free secretion from the intestinal surface, they tend materially to prevent congestion of the portal system. At the same time, drastic purgatives of all kinds should carefully be avoided. The most useful aperients are the electuary of senna, sulphur, and castor-oil, one or other of which should be taken regularly, twice or thrice a-week at bed-time, in as small a quantity as will be sufficient to keep the bowels free. In many cases the confection of senna may advantageously be given in combination with precipitated sulphur and the bitartrate of potass, equal parts of each of these being made into a mass with twice their quantity of the confection and a little syrup; of this electuary a dessert-spoonful may be taken every night or every second night. If there be a relaxed condition of the rectum and anus conjoined with the piles, as not unfrequently happens, in old as well as in young people, the administration of an electuary composed of equal parts of the confections of senna and of black pepper, or of cubebs, will be found very useful. In fact, in all cases in which the black pepper is administered, an aperient should be given from time to time to prevent its accumulation in the large intestine. When the liver is much obstructed, the treatment should be specially directed to the relief of this organ; with this view, a course of Plummer's pill, followed by taraxacum, and, in relaxed constitutions, the mineral acids, will be found especially servicable, at the same time that the bowels are kept free by gentle aperients.

The habitual use of lavements, consisting either of soap and water or thin gruel, will be found advantageous in many cases of piles, though in some they appear to irritate, and rather to increase the disease. When the piles occur in relaxed constitutions, the lavement should be used cold; but when the patient is of full habit of body, a tepid one will usually be found to agree best. In the general management of piles it need scarcely be observed that any habits which favor the disease should be sedulously avoided.

The *local treatment* of piles is of considerable importance. The parts should be regularly sponged with cold water, morning and evening. If there be much relaxation, and the piles are internal, benefit may result from the employment of some astringent injection, such as a very weak solution of the sulphate of iron, or of the tincture of the sesqui-chloride, a grain of the first, or ten drops of the second to an ounce of water; of this about two ounces may be injected every night, and left in the rectum. The application of an astringent ointment, such as the unguentum gallæ comp., will be attended by much benefit, or the employment of the anodyne and astringent suppository already recommended.

If the piles become inflamed, the patient should keep his bed, and leeches should be freely applied around, but not upon the tumors. Tepid lotions, poultices, and poppy fomentations, must be assiduously used, a very spare diet enjoined, and the bowels opened by mild saline aperients. If a coagulum form

in an external pile, as the result of inflammation, the tumor should be laid open with a lancet, and its contents either squeezed, or turned out with the flat end of a director. If abscess form, it must be punctured in the usual way, and the part afterwards poulticed. Should strangulation of the piles take place, the protruded swelling must be returned by gentle steady pressure and the part afterwards well poulticed.

2d. *Operation.*—The means above indicated are usually sufficient in ordinary cases of piles; but if in consequence of the inconvenient size that the disease attains, the general irritation and local uneasiness to which it gives rise, or the abundance of the hemorrhage being such as seriously to interfere with the health of the patient, it will become necessary at last to have recourse to operative interference, with a view of removing the diseased structures. No operation should ever be undertaken whilst the pile is in an inflamed state, lest unhealthy inflammatory action to an undue extent be set up in the part; it is also well to get the patient's health in a good state, as erysipelas may otherwise follow these operations, and before proceeding to them, care should always be taken that the bowels have been well opened. There are three plans of treatment adopted by surgeons for the removal of piles, viz., the excision of the tumor, its strangulation by ligature, or destruction by caustics. These methods of treatment should not be employed indiscriminately. The first is alone applicable to external piles, the two last may be adopted in the internal form of the disease.

The *removal of external piles* is readily effected. The tumor should be seized with a vulsellum, or hook, drawn forwards, and snipped off with a pair of knife-edged scissors, curved upon the flat. At the same time that the external piles are removed in this way, any pendulous flaps of skin in their vicinity should be excised, lest they become irritated, and constitute the basis of a fresh pile. After the excision of external piles there is usually but trifling hemorrhage, which may readily be arrested by the application of cold lint, or a pad and T bandage; should any small artery bleed, it may be pinched and thus stopped.

Internal piles should only be removed by the ligature; in fact it may be laid down as a rule in surgery, that all external piles should be cut off, and all internal piles tied. The reason of this difference in the practice to be adopted, according as the pile is situated above or below the margin of the anus, is the liability to hemorrhage in the one case, but not in the other. The bleeding that follows the excision of an external pile is not only small in quantity, but may readily be arrested by cold or pressure. With internal piles, however, it is different; these tumors are not only more vascular, being often fed by a large central arterial twig, but are deeply seated, and do not readily admit of the application of means for the arrest of the flow of blood from them. So difficult is it to stop the bleeding from an internal pile in some cases, that patients have actually lost their lives from this cause after its excision, even in the hands of some of the most distinguished surgeons. The excision of internal piles has consequently been very properly abandoned.

The *operation for the ligature of internal piles* may most conveniently be conducted in the following manner:—The patient having had his bowels cleared out by a dose of castor-oil on the day preceding that fixed for the operation, should have an abundant lavement of warm water administered about an hour before the surgeon arrives, and he should then be directed to sit for half an hour on a bidet, or over a pan containing hot water, bearing down at the same time so as to cause the piles to protrude. When all is ready, he should be laid on the bed on his left side, with the nates well projecting, the surgeon then seizes the most prominent pile with a hook, vulsellum, or broad-ended forceps (fig. 332), draws it well forwards, and ties its base as tightly as possible with a thin whip-cord ligature. He does the same to one pile after the other, until all that can be met with have been strangulated in this way. In some cases the pile is

so broad at the base that the ligature will not include it without transfixion; when this is required, it may usually be done readily enough by means of a nevus needle, or by the instrument represented in the annexed figure (333), Bushe's needle, which consists of a steel shank, fixed in an ivory handle, and having its free end perforated for the reception of a needle eye near its point. The advantage of this instrument is that not only is the angle formed by the needle and the shank a very convenient one for passing a ligature through a pile inside the anus, but more particularly that as the needle can be detached, it may, as soon as it is carried across the base of the tumor, be separated and so withdrawn more readily than it otherwise could. If the pile is longitudinal it may be deeply notched in a direction upwards at its lower attachment, and the ligature tied in the groove thus formed. In whatever way the ligatures are applied, care should be taken that they are tied as tightly as possible, so that the piles may be effectually strangled at once, as in this way they separate much more readily, and with far less pain to the patient than if loosely tied. When all the tumors requiring ligature have been tied, the ends of the threads must be cut off close, and the strangulated mass pushed back into the bowel. If there be any external piles, these must now be cut off, for unless this be done they become irritated, swollen, and inflamed by the presence of the ligatures, and constitute a source of much distress. The patient must now return to bed, and should keep the recumbent posture until the ligatures separate, which usually happens from the sixth to the eighth day, when an ulcerated surface will be left, which, however speedily closes and contracts. In some cases this process may be facilitated by the application of the nitrate of silver through a speculum ani. On the second day after the operation, the bowels may be opened with a dose of castor-oil. In the after-treatment of the case, care must be taken to prevent the recurrence of those causes that gave rise to the affection in the first instance. After piles have been tied, more particularly if they are seated towards the anterior part of the rectum, there is frequently great irritation set up about the neck of the bladder, so that the patient experiences difficulty in passing his urine, and sometimes suffers from complete retention; a warm hip-bath, and a full dose of hyoscyamus and nitric ether will usually relieve this, and enable the urine to pass. In some cases when the external piles are very large and vascular, and the patient debilitated, the ordinary rule of cutting them off may advantageously be deviated from, and a combination of the treatment by excision and ligature be adopted. In such cases, an incision may be made through the integuments merely, and then the piles tied in the course of the groove thus formed. By these means the pain and constitutional disturbance consequent on the inclusion of a portion of the integument in the ligature is avoided, at the same time that the risk of hemorrhage is not incurred.

Fig. 332

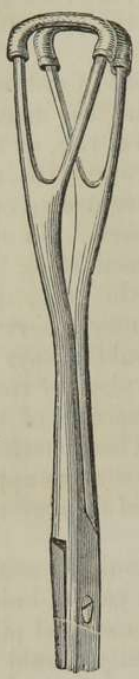
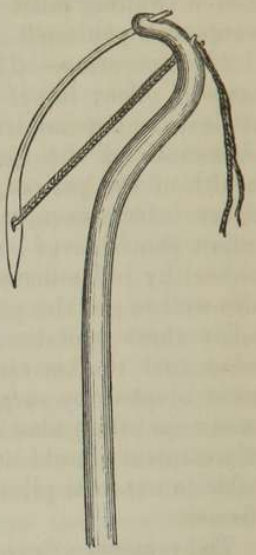


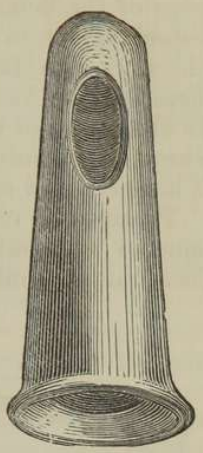
Fig. 333.



Treatment by caustics.—In certain kinds of internal piles, the application of nitric acid has been recommended by Mr. Houston of Dublin, and Mr. H. Lee, and may certainly advantageously be adopted. It must not, however, be applied

to the external or the intero-external pile, as it will produce extreme irritation, nor can it be looked upon as a substitute for the ligature in internal piles generally. It is especially in the granular pile, having an ulcerated surface, that this mode of treatment is useful, as in these cases it appears, by destroying a portion of the mucous membrane, not only to cure the pile to which it is applied, but by producing an ulcer, to give rise to a cicatrix, which by contracting, consolidates the parts in its vicinity, and so lessens the relaxed state of the rectum, which favors the hemorrhoidal tendency. The acid may most conveniently be applied through a speculum ani, having a circular aperture on one side (fig. 334). This should be introduced well oiled, until the pile project in the opening in it, when it must be freely rubbed with a piece of stick, or a glass rod or brush, dipped in the acid; the surface is then immediately wiped with a piece of lint saturated with prepared chalk and water, and the instrument removed. A thin slough separates, leaving a raw surface, which gradually cicatrizes and contracts. The application of the acid occasions but little pain when made fairly within the rectum, but if a drop of it accidentally come in contact with the muco-cutaneous surface, a vast deal of irritation and inflammation are excited. This plan of treatment, though useful in particular forms of pile, as when the tumor is granular or flat, so as not to admit of ready removal by the ligature, should not I think be practised when the ligature can be employed, as it is by no means so certain a mode of treatment. It cannot be considered altogether devoid of risk, for I have known one instance in which fatal erysipelas followed the cauterization of piles with nitric acid.

Fig. 334.



Pruritus ani is often an extremely troublesome affection, the itching and general irritation about the anus being almost unbearable. In many instances it appears to be a true prurigo of this part; in other cases it appears to be connected with the irritation of external piles, worms, or some similar affection. The treatment must in a great measure have reference to the cause. If there be an external pile, the removal of it, or if worms, their expulsion, will probably cure the disease. If it arise from prurigo, it will require some special treatment. In some cases the arsenical preparations will be found useful, together with the local application of chlorinated lotions, or those containing hydrocyanic acid.

PROLAPSUS ANI.

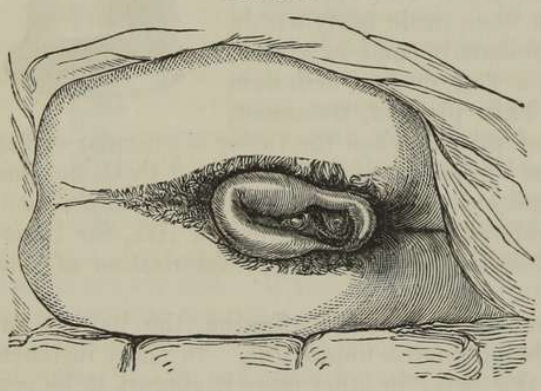
Prolapsus ani consists in a protrusion of the mucous membrane of the rectum through the anal orifice; the cellular tissue that lies underneath it being also in the majority of instances much thickened and elongated. In the ordinary prolapsus the muscular structures of the gut are not protruded; but yet it has occasionally happened that the muscular coat has descended with the mucous membrane, an invagination of the bowel taking place, which constitutes a different and far more serious condition than the ordinary prolapsus.

Prolapsus not unfrequently occurs in children, especially those who are feeble, or who suffer from much irritation of the digestive or urinary organs. In weakly persons generally there is a natural tendency to prolapsus, the slight protrusion of the mucous membrane that takes place during defecation being increased by any constitutional condition that gives rise to atony of the muscular system, more especially if irritation of the intestinal mucous membrane be conjoined with this, as in dysentery, chronic diarrhea, &c. So again the habitual constipation often occurring in persons of a relaxed habit of body, apparently proceeding from want of power in the rectum to expel its contents, and requiring

constant straining at stool, predisposes to this affection. It is especially common in those who labor under stricture, stone, or any other disease about the urinary organs that requires a considerable effort to be made in expelling the contents of the bladder. In persons whose constitution has been relaxed by a long residence in India, this disease also frequently occurs. In other cases again, and indeed most usually, the prolapsus is associated with piles, the weight and dragging of the hemorrhoid drawing down the mucous membrane with it. This is especially apt to happen when there is a general hemorrhoidal tendency about the anus. In fact the causes of prolapsus may be summed up under three heads. 1st. As dependent on simple relaxation of tissue, such as is met with in children and weakly persons. 2d. As owing to sympathetic irritation, as in chronic tenesmus, stone in the bladder, &c. And 3d. As being associated with a hemorrhoidal condition of the vessels of the part.

Prolapsus is readily recognized. It consists in the protrusion of a ring of mucous membrane of a red or purplish color, and having a somewhat turgid look, rather lobulated in shape and varying in size from half a walnut to a small orange (fig. 335). The mucous membrane covering this ring will be found to be continuous with that investing the sphincter, and this constitutes the mark of distinction between the ordinary prolapsus and the invagination that has occasionally been met with of the whole thickness of the gut; for in this affection, which is extremely rare, there is a deep and distinct sulcus between the protrusion and the margin of the sphincter. In prolapsus there is, when the protrusion is down, a dragging and smarting sensation, often attended with a good deal of spasm about the neck of the bladder, and not unfrequently with symptoms of stricture. In chronic cases, the anal aperture will appear to be permanently relaxed, and on introducing the finger into it, it will be found to be widened and weakened. The folds of skin in its neighborhood will be seen to be relaxed and elongated, radiating from it as from a centre; they are commonly bluish, soft, somewhat swollen, and pendulous, and often the seat of a good deal of irritation. The protrusion at first occurs only after defecation and then readily goes back of itself, or is reduced by the exercise of steady pressure upon it; after a time, however, it will come down at other periods; thus it may protrude after riding, walking, or even standing, and is returned with much difficulty.

Fig. 335.



Strangulation of the prolapsus may occasionally occur if it is allowed to protrude for a considerable length of time without a proper attempt being made to push it back. It then becomes swollen and livid with great pain and tenesmus, discharges a fetid ill-conditioned pus, and may eventually fall into a sloughy state.

The *treatment* of prolapsus may be said to be palliative and curative. The *palliative* treatment consists in the first place in reducing the tumor when protruded. This, under ordinary circumstances, the patient does for himself, but if it becomes congested it requires the help of the surgeon to put it back. This may occasionally be readily done by laying the patient on his side, or making him lean over the back of a chair, and then greasing the mass with some oil, seizing it with a soft towel, and by gradually compressing it, work it back. It may be kept up by the patient wearing a belt with a pad and elastic support.

Olive-shaped pewter pessaries are occasionally employed, with the view of preventing the protrusion, but I have never seen them of any service, the sphincter being usually too relaxed to keep them up, and their pressure appearing to excite irritation.

The regulation of the bowels is as important in cases of prolapsus as in piles. It is usually best done by the administration of those laxatives that have been recommended for the latter disease. It is a good plan in prolapsus to get the patient to have his daily motion at bed-time instead of at the usual hour in the morning, the recumbent position and the uniform temperature of the bed preventing that irritation of the sphincter and spasm of the anal muscles that commonly continues for some time after the reduction of the prolapsus, and which is a source of great discomfort when occurring in the early part of the day.

The relaxation of the mucous membrane of the rectum that essentially constitutes prolapsus may often be obviated by astringent injections or suppositories. The best injections are those of the sulphate of iron in the strength of from one to three grains in an ounce of water thrown up in small quantities sufficient for the bowel to retain. In children, injections of this kind, conjoined with regulation of the bowels by mild aperients, the administration of a moderate quantity of unstimulating food, and afterwards the employment of tonics, will commonly remove the disease, unless it arise from stone in the bladder, or some other affection inducing much and continued straining. In mild cases of prolapsus in adults, conjoined with a relaxed state of the mucous membrane of the rectum and relaxation of the sphincter, the use of the iron injections will be found particularly beneficial, at the same time that the action of the bowels is regulated by means of an electuary taken in the morning or at night. By thus giving tone to the bowel, at the same time that constipation is prevented, the disease will occasionally undergo a cure, provided it be not associated with any affection in other organs.

In those cases in which the prolapsus is hemorrhoidal, the protrusion being dragged down by the weight and strain of the pile, the same treatment must be adopted as has been recommended for the latter disease, and usually after the ligature and removal of the pile, the prolapsus will be cured. In slight cases of prolapsus, in which the disease appears rather to be owing to the relaxation of the sphincter and of the tissues external to it, the muco-cutaneous integument hanging in loose and pendulous folds around the anus, considerable benefit will commonly result by snipping off these pendulous flaps of skin; the cut surface that is left cicatrizing, and by its contraction bracing up the part, and thus preventing its further protrusion. These pendulous flaps are best removed in a radiating manner from the anal orifice, with curved knife-edged scissors.

When the prolapsus is considerable, and if the ordinary palliative treatment has, after a proper trial being given it, failed in effecting a cure, it will be necessary to remove the protruded mucous membrane by operation. This should always be done by the application of the ligature; excision, though easy, being objectionable in this as in the case of piles, on account of the danger from hemorrhage. The ligature should be applied in the following way: — The patient having had the bowels freely opened on the preceding day, and an enema of tepid water on the morning of operation, should be directed to sit over a pan of hot water, in order to make the prolapsus descend; it may then be seized with a pair of broad-ended forceps, such as are represented, fig. 332, and drawn well forwards. The base must next be firmly tied with a strong piece of whipcord, and a similar process repeated on the opposite side of the anus. Should there be any difficulty on account of the shape of the protrusion in ligaturing the base firmly, this may be obviated by transfixing it with a hemorrhoidal needle, and tying it on either side. I think, however, that it is better, if possible, to avoid doing this. The ends of the ligature must then be cut short, the whole protrusion returned into the bowel, the external flaps of skin cut off, and

an opiate pill administered, so as to arrest all peristaltic action for a few days. Should the ulcerated surface show any difficulty in healing, it should be touched with the nitrate of silver. This operation always leaves a permanent cure.

The ligature of prolapsus, like that of *internal* piles, is not very painful, and for it chloroform need not be administered; indeed, it is, perhaps, better that it should not be given in these cases, as the protrusion is apt to slip up under its influence, the patient not being able to exercise the proper expulsive efforts. But as the excision of the external flaps and piles is attended by very sharp suffering, it is as well to administer the anæsthetic at the time that they are being removed.

Should a prolapsus become strangulated, it would be necessary to try to reduce it through the sphincter by the employment of the taxis; if this cannot readily be accomplished, free incisions may be made into it; if it be not reduced, it will slough away, and thus undergo permanent cure. In some rare cases, a portion of invaginated intestine descending through the anus has become strangulated; in such cases as these, reduction must be effected if possible without, but if necessary with, division of the sphincter.

RECTAL FISTULÆ.

Fistulous openings occasionally occur between the rectum and the bladder in men; or between this gut and the vagina in women.

The *recto-vesical fistulæ* are of very rare occurrence, and usually result either from organic disease of a cancerous character, establishing a communication between the rectum and the bladder or by a wound of the gut during the operation of lithotomy. In these cases the urine escapes per anum in greater or less quantity, occasioning constant irritation or excoriation of these parts, with a sort of liquid diarrhea, and the wet state in which the patient is kept by the dribbling of urine gives rise to an offensive ammoniacal odor about him. If the communication between the rectum and bladder be a free one, feculent matter and flatus get admission into the urinary organ, and escape from time to time by the urethra; perhaps even more abundantly than the urine does per anum. This is especially the case when the fistula is carcinomatous, and it is remarkable how little irritation is often set up by this admixture of fæces with urine in the bladder. The fistulous aperture in the rectum can always readily be detected by passing the finger into the gut, or examining its interior with the speculum ani.

If the disease be of a cancerous character, nothing can be done in the way of treatment beyond keeping the parts clean; but if traumatic in its origin, of small size, and more especially if it be recent, its closure may not unfrequently be accomplished by touching it with the nitrate of silver, or a red-hot wire through a speculum ani. In these cases, the platinum loop made red-hot by the galvanic current, according to Mr. Marshall's plan, might advantageously be employed. If, however, the fistula be of old standing, and the aperture large, cauterization would probably not succeed, and then perhaps the only mode of treatment that could be adopted would be to introduce a grooved staff into the urethra, and cut through the sphincter upon this, thus laying the parts into one, and converting the anal into a perineal fistula; then by keeping the catheter in the bladder, and emptying this, granulations will spring up, and deep union be accomplished.

Entero-vaginal fistula. — It has happened that a communication has been set up between the small intestine and the vagina, an artificial anus in fact forming in this cavity. These cases, however, are very rare, and may indeed be looked upon as incurable; for though some of the French surgeons, as Roux and Casamayor, have endeavored to establish by a deep and difficult dissection a communication between the small and large intestine, the operation, as might have been expected, has proved fatal to the patient.

Recto-vaginal fistulæ are usually the result of sloughing of the posterior wall of the vagina, in consequence of some undue pressure exercised upon it during parturition. The size of these fistulous openings varies greatly; sometimes there is merely a small perforation, at others there may be loss of the greater portion of the posterior wall of the vagina. Whatever their size, they are necessarily sources of very great discomfort and annoyance, both physical and mental, to the patient. The recognition of the disease is of course at once made; the escape of fæces and flatus into the vagina being obvious, and digital or ocular examination through the two-bladed speculum at once detecting the seat and extent of the aperture. As there is just the possibility of the communication existing between the vagina and the small intestine, it may be useful to bear in mind that when this has been the case, the feculent matter that escapes has been found to be yellower and less stercoraceous that when the rectum is opened.

If the fistula be small and recent, it may occasionally be closed by attention to cleanliness, at the same time that its edges are touched with the nitrate of silver, a hot iron wire, or the platinum loop. If it be very large, the greater part of the posterior wall of the vagina having been destroyed, it will probably be incurable; but even here the patient should not be left to her fate, and some operation should be attempted which might lessen its size, even if it do not completely close it. The operation for the closure of a recto-vaginal fistula consists, after emptying the patient's bowels by purgatives and an enema, in introducing a bivalve speculum into the vagina and through the opening in it, freely paring the edges of the aperture. The next point is to bring its edges into apposition, and in doing this, the recommendation made by Copeland and Brown of dividing the sphincter ani should always be acted on, as it is a most important auxiliary to the success of the operative procedures that are required; for as there is always loss of substance in these fistulæ, there is necessarily a great tendency to tension on their sides when any attempt is made to draw them together; and it is also of importance that any muscular movement about the parts in the neighborhood of the fistula should be arrested, as this might otherwise break down union after it had taken place between the edges. The sides of the fistula must then be drawn into apposition by sutures introduced by means of the corkscrew needle, and knotted as in the operation for cleft palate, or by means of the bead suture. The success of the operation depends not only on the proper completion of the steps of the operation, but greatly on the after-treatment. This should consist in the administration of opium, to prevent the bowels acting for several days; indeed, until union has taken place between the edges. They may then be moved by means of laxatives and oleaginous enemata carefully given. During the treatment, the parts should be disturbed as little as possible, and the urine drawn off every sixth hour. The patient must be kept upon a very moderate diet, and the stitches may be left in for six or eight days, when they must be cut out and carefully removed. Should any point of the fistula not be closed, the application of the nitrate of silver may induce proper union of it.

TAPPING THE ABDOMEN.

The abdomen often requires tapping, either for ascites or encysted dropsy. The operation, which is perhaps the simplest in surgery, may be performed as follows: — The bladder having been emptied, the patient is seated on the edge of the bed or of a large chair, or if very weak lies on the side, and has a broad flannel roller, split at either end to within six inches of the middle, passed round the body in such a way that the untorn part covers the front of the abdomen, whilst the ends which are crossed behind are given to an assistant on either side, who must draw tightly upon them as the water flows. The surgeon then seating himself before the patient, makes a small incision with a scalpel

into the mesial line about two inches below the umbilicus, and through the opening thus made, he thrusts the trochar; as the fluid escapes, the patient often becomes faint, but this may commonly be guarded against by continuing to draw upon the bandage so as to keep up good pressure in the abdomen. After all the fluid has escaped, the aperture must be closed with a strip or two of plaster supported by a pad and bandage.

The incision through which the trochar is thrust need not enter the peritoneum, though if it does it matters little. The trochar itself must be of full size with a well-fitting canula. Sometimes it is convenient to have one fitted with a stop-cock, to the end of which a vulcanized india-rubber tube may be adapted, by which the fluid is carried quietly and without splashing into the pail destined to receive it. Should the particular character of the accumulation of fluid in encysted dropsy not admit of its withdrawal by an aperture below the umbilicus, the abdomen may be tapped in any other convenient situation, except in the course of the epigastric vessels.

DISEASES OF THE GENITO-URINARY ORGANS.

CHAPTER LVI.

DISEASES OF THE BLADDER AND PROSTATE.

CYSTITIS.

Idiopathic inflammation of the bladder is of rare occurrence; this disease most commonly originating either from traumatic causes, as from the passage of instruments, the irritation of broken fragments of calculus, &c., or it may arise from irritation produced by the application of blisters, the administration of diuretics, or directly from the extension of gonorrhea to the interior of the organ.

The *symptoms* of cystitis consist not only in the local pain and weight about the hypogastric and iliac regions, with tenderness on pressure in these situations, and a good deal of constitutional irritation; but in the existence of extreme irritability about the bladder. So soon as a few drops of urine collect they excite so much irritation in this viscus that they cannot be retained, and are expelled by a kind of spasmodic or convulsive effort, often accompanied by a good deal of tenesmus and great suffering. The urine will be found to be high colored, mixed with more or less mucus or pus, and often tinged with blood.

An acute attack of cystitis usually terminates in the chronic form of the disease, and thus gradually undergoes resolution; occasionally, however, it terminates fatally, and when this is the case the patient's symptoms commonly assume an ataxic character, the tongue becoming brown and dry, the pulse rapid and weak, and the urine very offensive. On examination after death, it will commonly be found that the inflammation of the bladder has gone on to gangrene of the mucous membrane, to diffuse peritonitis, or to the formation of abscess either in the substance of the wall of the bladder or between the bladder and the rectum, with perhaps infiltration of urine in the deep cellular tissue of the pelvis or the perineum.

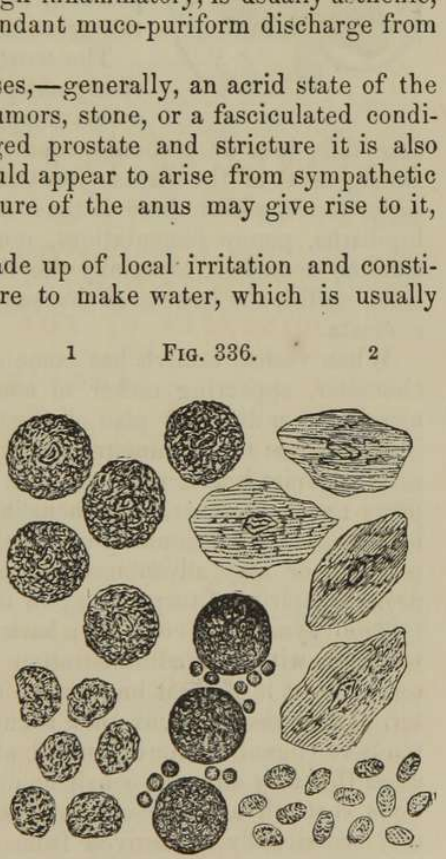
The *treatment* of cystitis is of a very simple character, the disease admitting of little being done in the way of medicines. The free application of leeches to the neighborhood of the inflamed organ, long-continued soaking in warm hip-baths, the application of poppy fomentations or of laudanum and linseed-meal poultices, the injection of emollient enemata, and the copious administration of barley-water or mucilaginous drinks, will subdue the inflammation and afford the patient great comfort; to these means may be added the administration of antimonials with henbane or opiates. The only salines that are of much use are the citrate and nitrate of potass, and these must be given largely diluted.

The acute cystitis commonly degenerates into the chronic form of the disease, or, as it is frequently called, the *irritable bladder*, though this may set in originally in a subacute form as the result of gonorrhea, in connection with gout, or from the presence of calculi. The symptoms in this affection are much the same as in the acute variety, though necessarily in a minor degree; there is pain and a sensation of weight on holding the water, a very frequent desire to pass it, with pains about the pelvic region. This disease not unfrequently lasts almost an indefinite time, eventually degenerating into *vesical catarrh*. This form of irritation of the bladder, though inflammatory, is usually asthenic, and is principally characterized by an abundant muco-puriform discharge from its interior.

It may arise from a great variety of causes,—generally, an acrid state of the urine, or disease in the bladder, such as tumors, stone, or a fasciculated condition of that organ, occasion it. In enlarged prostate and stricture it is also commonly met with. In some cases it would appear to arise from sympathetic causes; thus, the irritation of a pile or fissure of the anus may give rise to it, or it may be dependent on renal disease.

In *vesical catarrh* the symptoms are made up of local irritation and constitutional debility. There is frequent desire to make water, which is usually ammoniacal and fetid, and is mixed with a large quantity of glutinous, stringy mucus, which gives it a turbid appearance. The urine, on standing, separates into two parts, the upper being clear, but the lower consisting of a thick, viscid, slimy or gummy mucus, often semi-opaque and purulent in appearance; it sticks tenaciously to the bottom of the pot, and when poured out hangs from the edge in long, stringy masses (fig. 336). It is often mixed with urinary deposits, more especially of a phosphatic kind.

1 FIG. 336. 2



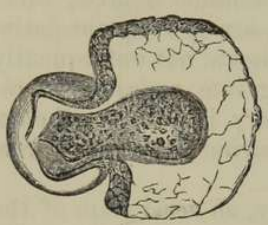
1. 1. Mucus. 2. Epithelium. 3. Pus. 4. "Organic Globules," met with in the urine.

This chronic form of inflammation of the bladder is not unfrequently fatal, death resulting eventually with symptoms of a typhoid character; the tongue becoming brown and the pulse feeble, and these are usually associated with urinary poisoning of the blood, the mental manifestations becoming dull and obscured, and the body emitting a strongly urinous odor, and the skin a dense, clammy sweat.

On examining the bladder after death in such cases, great thickening of the muscular coat of the mucous membrane will usually be found, together with a dilated and tortuous condition of the veins ramifying upon it, the blood contained within which is peculiarly black. Abscesses may be found in the walls or outside them, circumscribed and bounded by plastic matter. The mucous

membrane is thrown into folds and ridges, which become thickened and hardened, having irregular depressions between them, so as to cause the interior of the bladder to resemble somewhat the inside of one of the cavities of the heart with its projecting columnæ carneæ. This fasciculated condition is almost an invariable accompaniment of long-continued chronic inflammatory irritation of the bladder. As the organ becomes hypertrophied, in consequence of the continuance of the disease, it usually becomes sacculated, the cysts forming at its posterior or lateral parts. The sacculi are of two kinds, both of which are formed by projections between the fasciculi of the wall of the bladder. In the first and least common kind, the muscular as well as the mucous coat is pushed outwards. In the second form of cyst, the mucous coat alone forms a kind of hernial protrusion (fig. 337). In the cysts thus formed, accumulations of various kinds may take place: mucus, pus, sabulous matters, and even calculous concretions not unfrequently being met with in these situations. It is the retention of urine, mixed with mucus or pus in these cysts, where it undergoes decomposition, that is a common cause of the great fetor of the urine in such cases.

Fig. 337.



The *treatment* of chronic cystitis must be of a moderately antiphlogistic character, so long as inflammatory action keeps up; when once this subsides and the disease falls into an asthenic condition, or degenerates into vesical catarrh, the management of the disease must to a considerable extent be modified. In the early stages, whilst there is tenderness and inflammatory action, leeches, warm hip-baths, poppy fomentations, mucilaginous drinks with henbane, and some alkaline remedies, especially the liquor potassæ largely diluted, will be found most useful, the bowels at the same time being kept open with castor-oil and enemata.

When vesical catarrh has come on, and the disease has lost its inflammatory character, appearing rather to consist of atonic exudation from the mucous membrane, a different plan of treatment will require to be adopted. In such cases as these the administration of vegetable astringents, as the uva ursi, buchu, or the pareira brava, with henbane and nitric acid, will often be of service. In many cases, however, most benefit is derived from the administration of the balsams, more particularly of copaiba. It may either be given with the liquor potassæ, or may advantageously be administered in combination with a few drops of spirits of turpentine; in the more advanced forms of the disease, when typhoid symptoms come on, bark and ammonia will be found most useful, together with the administration of the brandy-and-egg mixture. In these cases also it is of great importance to empty the bladder, by means of the catheter, of the viscid mucus that accumulates in it, and the putrefaction of which tends to engender the depressed state into which the patient sinks. In some cases this may advantageously be done by washing it out with warm water injections through a double-current catheter. In this stage of the disease benefit may occasionally be derived from the employment of very slightly astringent injections. Amongst the most useful of these will be found the nitrate of silver, in the proportion of one grain to four or six ounces of tepid distilled water. Sir B. Brodie has advantageously employed water very slightly acidulated with nitric acid.

A peculiar form of chronic inflammation of the mucous membrane of the bladder is occasionally met with in strumous children, and appears to be an affection closely allied to the congestive and subacute inflammatory conditions of the different mucous membranes, as of the eyes, nose, and throat, that commonly occur in such subjects. In this disease the child makes water with great frequency and with much pain, the urine is offensive, and usually phosphatic,

and not unfrequently there is a good deal of uneasiness complained of about the groins and along the penis. On sounding the bladder it will be found roughened, fasciculated, and often containing sabulous matters mixed with mucus; occasionally there is a good deal of gastro-intestinal irritation, and not unfrequently worms are present. The treatment should consist in attention to the general improvement of the health of the patient, in the removal of intestinal irritation, the regulation of the digestive functions, and in the administration of copaiba in small doses, either alone or conjoined with a few minims of liquor potassæ, at the same time that general anti-strumous treatment must be properly carried out.

Irritability of the bladder in women not unfrequently occurs, and simulates stone so closely that it is only after very careful sounding that the surgeon is satisfied that no calculus exists. This condition appears to be dependent on a morbidly sensitive state of the mucous membrane of the urethra and bladder, that may arise from a variety of causes; in some cases it is a truly neurotic or hysterical condition. In other instances it is sympathetic, being connected with some local disease of the genito-urinary organs, with a vascular tumor at the meatus of the urethra, or some affection of the uterus, which will require to be cured before the bladder can be got into a sound state. Prolapsus of the anterior wall of the vagina, drawing down the corresponding portion of the bladder, will keep up this condition; if so, the prolapsus must be cured by some plastic operative procedure. Under all circumstances, however, when this state has once been set up, it is very difficult to remove. In many cases it is undoubtedly due to the irritation produced by a morbid state of the urine dependent on malassimilation, and usually connected with an excess of lithates. In such cases as these, careful regulation of diet, and the administration of potass with henbane or copaiba, will afford much relief; but the complaint is of a very chronic and intractable nature, and under the most careful treatment will often continue for years.

TUMORS OF THE BLADDER.

Fungous growths or polypi are occasionally met with in the bladder, flat, pedunculated, or pyriform in shape; they may occur at all ages, and usually give rise to a certain degree of irritation in this organ, which is especially marked when they occur in the vicinity of its neck, where they may even cause retention of urine and some of the symptoms of stone. These fungous growths occasionally are of a malignant character, and then give rise to bloody urine, in which cancer-cells and debris may be found on microscopic examination, thus serving as a diagnostic mark of the nature of the disease. Malignant fungus or cancer of the bladder is usually associated with similar diseases of the prostate or neighboring structures, and in women may be secondary to cancer of the uterus. According to Walshe it does not appear before the fortieth year. These tumors, whether simple or malignant, occasionally become incrusted with calculous matter deposited upon them by the urine; and then they will resemble still more closely a calculus when the bladder is sounded; from it, however, they may be distinguished by their fixed character, and by the impossibility of getting a sound around them. Some difficulty is often experienced in examining the bladder in these cases, for as the fungous mass pushes back the posterior wall of the viscus, it has a tendency to elongate the prostatic portion of the urethra and the neck of the bladder, so that a very long instrument is required to reach it. Little can in general be done in the way of treatment in this disease, though the example of Civiale might, in some cases, be advantageously followed, who removed a small growth seated at the neck of the bladder by seizing and twisting it off with a lithotrite. And Warner has recorded a case in which a tumor of this kind, the size of an egg, was tied in the bladder of a woman after dilating her urethra.

Hematuria, or bloody urine, is a common consequence of the ulceration of malignant disease of the bladder or prostate. It may, however, arise from various other causes, as from congestion of the kidneys, from the irritation of calculi, or it may be of a passive nature. Usually the blood passes away mixed with urine, but sometimes it accumulates in large quantity, filling up the bladder with a soft fibrinous coagulum, and causing it to reach to the umbilicus and to feel like a gravid uterus.

In most cases the hemorrhage may be checked by the administration of gallic acid, or the sesquichloride of iron. The bladder may be emptied by an ordinary catheter, but when distended by coagulum, it may be necessary to wash it out by injecting warm water through a double-current catheter. If decomposition occur in the coagulum giving rise to the formation of flatus in the bladder, a weak tepid saline solution, to which a little creosote has been added, may advantageously be used.

PARALYSIS OF THE BLADDER.

Paralysis of the bladder may occur with the opposite conditions of retention and incontinence of urine, according to the part of the organ that has lost its contractile power. When the body of the bladder is paralyzed, whilst the neck preserves its contractility, retention of urine will ensue in consequence of simple inability on the part of the organ to expel its contents, and not from the existence of any mechanical obstacle to the outward flow of the urine. When, on the other hand, it is the neck of the bladder that is paralyzed, whilst the body of the viscus retains its contractility, the urine cannot be retained, but dribbles away involuntarily, thus constituting incontinence.

Loss of tone in the body of the bladder, leading eventually to its paralysis, not unfrequently occurs in old age as the result of simple diminution of muscular power; or it may happen as a consequence of fever, or as one of the symptoms of paraplegia, from whatever cause arising. It may occur suddenly in cases of injury in which the lower part of the spinal cord is paralyzed.

When coming on slowly as the result of disease, the patient usually finds that the water escapes in a dribbling manner; that there is some difficulty in emptying the bladder completely; and that there is not that forcible ejection of the last drops of urine that is characteristic of a healthy tone in the organ; at the same time there is not unfrequently a tendency to the dribbling away of a few drops towards the end of the emission of urine, and after its apparent cessation. There is also an occasional escape of urine at night. When complete retention occurs, whether this take place gradually or suddenly, the bladder slowly enlarges, rising at last out of the pelvis into the abdomen, stretching up into the hypogastric region, reaching even as high as the umbilicus. On examining the lower part of the abdomen, the organ will be felt hard, elastic, rounded, and pyriform in shape, projecting above the pubes, and feeling much like an enlarged uterus. In this situation, also, percussion will elicit a dull sound, and on exploring the part through the rectum the bladder will be found to project in this direction also, and on tapping with the fingers above the pubes, fluctuation may be felt through the wall of the gut. After the bladder has once become distended, it commonly happens that a quantity of urine continues to dribble out of it; in fact the amount that escapes in this manner may be very considerable, though the retention continue unrelieved. This *retention with dribbling* is a condition of much practical importance, as the continued escape of urine may lead the patient, and even the surgeon to overlook the true nature of the disease; the more so as in elderly people retention slowly induced often occasions but little inconvenience. I have drawn off nearly a gallon of urine from a patient in whom it had not been suspected that retention existed, in consequence of the continuance of this dribbling. In women, re-

tention is not by any means so common as in men, but the bladder will sometimes attain an enormous size, rising as high as the umbilicus; and such enlarged bladders have been tapped under the supposition of the tumor being an ovarian cyst or some similar growth. I once witnessed such a case, in which the surgeon, to his surprise, on tapping the tumor drew off a quantity of clear and healthy urine instead of ovarian fluid; fortunately no bad effects followed. This *retention with dribbling* occurs in consequence of the bladder, as it rises out of the pelvis, elongating its neck; and as the body becomes bent forward over the pubes, a sharp curve or angle is formed at the junction of the neck and body of the viscus, through which a small quantity of urine continues to dribble away, and escapes rather by its own gravity than by any expulsive effort on the part of the patient.

The *retention from paralysis* can readily be diagnosed from retention from obstruction, for on introducing the catheter, when the patient is lying on his back, the instrument will not only readily enter, but the urine will simply flow out in a uniform stream, not being projected in a jet by the contraction of the walls of the organ, but rising and falling in obedience to the respiratory movements. The urine that escapes in a case of retention will always be found to be high-colored and very ammoniacal, its specific gravity is also considerably increased in consequence probably of the absorption of its more watery constituents.

The continuance of retention of urine from paralysis of the bladder, will probably give rise to fatal consequences; a sub-acute inflammation taking place in the mucous membrane of the organ which falls into a sloughy condition, accompanied by symptoms of a typhoid type. In some instances coma comes on, owing to the poisoning of the system by the absorption of the urinary constituents. Even though the retention be relieved, this condition is apt to come on; vesical catarrh with fetid urine supervening, the tongue becoming brown, and low fever setting in. It is very seldom that the bladder ulcerates or bursts when the retention arises from paralysis of that organ independent of any mechanical obstacle, the continued dribbling preventing this consequence.

The *treatment* of this form of retention must have reference to the cause of the paralysis of the bladder; but under all circumstances the urine must be drawn off regularly, as the over-distension of the organ not only keeps up its paralytic state, but may occasion serious consequences by inducing chronic inflammation of it. A large catheter must accordingly be introduced regularly twice a day, even though retention be not complete, and in doing this, care must be taken that the beak of the instrument properly enters the body of the bladder, which is further removed from the pubes than usual; for it will sometimes happen that it may get into the dilated prostatic part of the urethra, or elongated neck of the bladder, when an ounce or two of urine escaping, it may be supposed that there is no more left behind, though in reality the viscus is immensely distended. In order to get the catheter well in, its point should be closely hooked round the pubes and raised by depressing the handle between the thighs. In cases of paralysis, the catheter should not be allowed to remain in the bladder, lest its point pressing against the mucous membrane increase the tendency to low cystitis, or give rise to sloughing.

If the retention arise from paralysis dependent on injury or disease of the spine, it will occasionally be found that strychnine either administered internally, or applied endermically will tend to lessen it. If from old age, the administration of cantharides, or the application of a blister to the sacrum may be of use. In some cases the application of cold to the inside of the thighs or abdomen, will facilitate the contraction of the organ, hence it is the custom of some old men laboring under this affection to press the chamber utensil against the inside of the thighs, and I have known a patient find more relief by sitting on the marble top of his commode, than in any other way.

Incontinence of urine arises from weakness of the neck of the bladder, in consequence of which there is not sufficient power to hold the contents of the organ, and the water dribbles out. In most cases the sphincter-like action of the neck is not perhaps quite lost, so that a small quantity is ejected from time to time, the urine in fact escaping so soon as enough has accumulated to overcome the slight resistance offered by the partial contractility of this part of the bladder. When there is paralysis of the body of the bladder as well as of the neck, the urine dribbles out as fast as it is poured in by the ureters.

Incontinence of urine, consequent upon weakness of the neck of the bladder, may arise from a variety of causes; it is most frequent in children, in whom it occurs during sleep, the patient losing the command over the sphincter so soon as a small quantity of urine has accumulated behind it. In old people it may arise from simple debility, and is commonly associated with a tendency to retention. In many cases it is sympathetic, dependent on the irritation of piles, stricture of the urethra, or stone in the bladder, and occasionally results from nervous causes, more particularly in women of an hysterical temperament. Over-distension of the bladder will occasion incontinence of urine, not from paralysis, but from a kind of strain of the muscular structures of the part; in this way a patient, who from circumstances has been unable to empty his bladder for a considerable time, may suffer from incontinence. In children of a strumous habit, incontinence of urine is very apt to occur, the child wetting its bed an hour or two after it goes to sleep. In such cases the urine will generally be found to be loaded with lithic acid crystals.

The *treatment* must depend upon the cause. When arising in weakly children, if it be not connected with worms or gastro-intestinal irritation, which should then be removed, the administration of tonics will be found useful,—either quinine or the tincture of the sesquichloride of iron, alone or conjoined with tincture of lytta. If there be irritation of the mucous membrane of the bladder, the administration of alkalies, in conjunction with a tonic, as the potassio-tartrate of iron, or a little copaiba mixed with honey, will be found a very serviceable remedy; cold sponging, light clothing at night, and means calculated to break the habit, such as waking the child at the time at which it generally occurs, changing his position in bed, &c., should not be omitted. When occurring at a more advanced period of life, if there be any source of sympathetic irritation, this must be removed; if none can be discovered, tonics, especially iron and lytta, with strychnine and galvanism, must be had recourse to, together with cold douching or shower-baths.

Hysterical retention and incontinence not unfrequently occur in nervous girls, and require to be treated by anti-hysterical remedies, amongst which the preparations of the sesquichloride of iron, either alone or with valerian, will be found most useful. Cold douches are also of great service. In cases of hysterical retention, it may sometimes be necessary to use the catheter; but under such circumstances it is well not to employ this instrument too frequently, as the patients are apt to get into the habit of having it introduced, and will, with that morbid propensity that characterizes hysteria, continue for a length of time to require its introduction. If left to themselves, though the bladder may become much distended, it will not burst, but will probably empty itself without further trouble, more particularly if the patient is put into a tub and well douched over the hips and loins with cold water. In some cases these morbid conditions in women appear to be connected with some local irritation about the urethra or uterus, and then proper treatment must be directed to these organs before the disease can be cured.

The bladder is often the seat of severe pain, either continuous or remittent, without any disease being discernible in it on the closest examination; the pain being either a kind of neuralgic condition, especially occurring in hysterical or hypochondriacal patients, or else being sympathetic with and dependent on dis-

ease at a distance, as in the kidneys, uterus, rectum, &c. At the same time it must be borne in mind, that the secretion of acid or irritating urine will, in some individuals, be a source of much and constant suffering; and that any disease seated about, or coming in contact with, the neck of the bladder, as tumor, stone, &c., is especially apt to give rise to severe suffering, and will in many cases be accompanied by frequent desire to micturate, with much spasm about the part.

Extroversion of the bladder, consisting in an absence of the anterior wall of that organ, with deficiency in the corresponding part of the abdominal parietes, is occasionally met with as a somewhat rare congenital malformation. In these cases the posterior wall of the bladder being pushed forwards by the pressure of the abdominal viscera behind, forms a rounded tumor about the size of a small orange just above the pubes. The surface of this tumor is red, vascular, and papillated, evidently composed of mucous membrane; at its lower aspect the orifices of the ureters will be observed to open and to discharge the urine in drops or in a stream. For a full description of the mechanism of the passage of the urine in these malformations, I would refer to a case that fell under my notice, and in which I made a number of experiments on the rapidity of the passage of foreign matter through the kidneys, reported in the Medical Gazette for 1845. This malformation is incurable. Operations have been planned and performed with the view of closing in the exposed bladder by plastic procedures, but they have never proved successful, and have terminated in some instances in the patient's death; they do not therefore afford much encouragement for repetition. The patient should, however, wear a properly constructed instrument to receive and collect the urine; consisting of a hollow shield strapped over the part, communicating by means of a tube with an India-rubber bottle that may be attached along the inside of his thigh.

DISEASES OF THE PROSTATE.

The prostate is subject to acute and chronic inflammation, to hypertrophy, scirrhus, and the formation of calculi.

Inflammation of the prostate or *prostatitis* very rarely occurs as an idiopathic affection, but is most commonly met with as the result of gonorrhea, more especially in middle-aged men, rarely in those under twenty-five or thirty. The symptoms of prostatitis are deep-seated pain, heat and weight in the perineum with a frequent desire to make water, and very great and spasmodic pain accompanying the emission of urine; in fact the irritability that is set up about the neck of the bladder is perhaps the most marked and distressing feature in the disease. These symptoms are, however, common to various inflammatory affections of the urinary organs, and they can only be distinctly referred to the inflamed prostate by rectal exploration. On introducing the finger into the gut, the prostate will be found much enlarged and exquisitely tender to the touch; and the patient often suffers considerably from the pressure of the inflamed organ upon the rectum during defecation.

The *treatment* of acute inflammation of the prostate, should be of an active antiphlogistic character, so as to prevent, if possible, the formation of abscess in it. The perineum must be cupped or well leeched, warm hip-baths, and poppy fomentations assiduously employed, and salines with antimony administered. In this way the formation of abscess within or around the prostate may in many cases be prevented.

Prostatic abscess may happen either as a consequence of acute inflammation running into the suppurative stage, and in this way it is not very unfrequently met with as a complication of gonorrhea; or it may occur with comparatively little antecedent inflammation—as sometimes happens in pyemia, or if the organ is accidentally bruised during lithotrity. In these cases, abscess perhaps as frequently forms in the cellular envelope as in the organ itself. Idiopathic

suppuration of the prostate, irrespective of any of the above causes, is, however, of rare occurrence, but a case happened to me some time ago in which, without any apparent reason, after the operation for strangulated hernia, a purulent collection formed in this situation.

When inflammation of the prostate terminates in abscess, rigors with throbbing and perhaps retention of urine occur. In all cases the perineum becomes brawny, or, tenderness of the gland, and deep fluctuation may be felt through the rectum. When left to itself, this abscess most usually gives way into the urethra, but it may, especially when occurring in the prostatic capsule, open externally into the perineum or into the rectum. In many cases the abscess presenting on the urethral surface of the prostate is burst during the introduction of the catheter, used for the relief of the retention of urine induced by the pressure of the tumefaction; the matter escaping along the side of and through the instrument.

So soon as it can be ascertained that abscess has formed in the prostate, the pus should be let out by a deep incision into any brawny or indurated mass that can be felt in the perineum. The surgeon must not wait for fluctuation, but must cut deeply in the direction of the matter, keeping, however, in the mesial line. Even if none escape at first it may do so if the part is well poulticed for a few hours, and thus communication with the urethra or rectum be prevented.

In prostatitis, retention may occur from the swelling of the organ, the infiltration of exudative matters around it, or the formation of pus in it. In these cases the neck of the bladder will be carried to a considerable distance from the surface, and may very probably not be reached by an ordinary catheter, which may be buried up to the rings and yet not enter the cavity of that organ; under these circumstances a silver prostate catheter should be employed, and this must be carefully introduced, lest by getting into the cavity of an abscess which has already burst per urethram, it might be supposed to have entered the bladder itself. In introducing the instrument under these circumstances, care should be taken to keep its point constantly in contact with the upper surface of the urethra, and to hook it round the pubes. The *upper* surface of the urethra is a sure guide to the bladder; for any abscess, false passage, or irregularity of direction will always first affect the lower aspect of this canal, as being surrounded by yielding structures, whilst the upper part being firmly supported by bone and ligament cannot so readily alter its direction.

Chronic sub-acute inflammation of the prostate not unfrequently occurs in cachectic and debilitated individuals as an idiopathic affection; but, in other cases, it is connected with gonorrhea, or some local irritation. In this form of the disease, there is not only heat, weight, and pain in the region of the gland, with tenderness on rectal exploration, but there is usually a considerable discharge from time to time of a viscid, ropy mucus, the morbid secretion of the follicles of the gland, which is frequently mistaken for spermatorrhea. This discharge is occasionally ejected by the acceleratores urinæ muscles, which are irritated by extension of morbid action to them, and is at other times squeezed out when the patient goes to stool, by the pressure of the fæces and the action of the anal muscles. In most cases its continuance is accompanied by a good deal of irritability about the neck of the bladder, and debility of the generative organs. Its existence is a source of much distress to the patient, whose mind usually becomes harassed by the dread of impotence. The discharge, however, is not seminal, and may always be distinguished from true spermatorrhea by the absence of the characteristic spermatozoa.

The treatment of these cases must consist in the gradual removal of the local inflammatory action by the application of leeches to the perineum, by warm hip-baths, and if some chronic enlargement of the prostate has taken place, by the administration of small doses of the bichloride of mercury in compound tincture

of bark. Should the patient suffer much in making water, liquor potassæ, with a small quantity of copaiba and tincture of henbane will be useful. In some cases much advantage will be derived from the repeated application of blisters to the perineum.

Hypertrophy and tumors of the prostate. — Chronic enlargement of the prostate may be looked upon as a senile disease, seldom occurring before the age of fifty, and being commonly met with after this; at that period of life, as Sir B. Brodie observes, when the hair becomes grey and scanty, when atheroma begins to be deposited in the coats of the arteries, and when the arcus senilis forms on the cornea, the prostate often becomes increased in size. At the same time, however, other changes take place in the genito-urinary system; thus the urethra becomes dilated and the bladder thickened, and unless the enlargement of the prostate advances in too great a proportion to the other changes, so as to interfere with the free escape of the urine, no disease can properly be said to be established. If we look upon the diseased enlargement of the prostate as such an amount of hypertrophy of the gland as interferes seriously with the discharge of the urine, we shall probably not find it so frequent even in old men, as is generally supposed. Guthrie states that it is not commonly found in the pensioners at Greenwich Hospital. Mr. Henry Thompson has found that an enlargement appreciable after death existed in 30 per cent. of men above the age of 50; but that such a degree of enlargement as to give rise to symptoms during life was only met with in 12 per cent. of the cases he examined. Though age must be looked upon as the primary cause of this particular hypertrophy of the prostate, there can be little doubt that it may be predisposed to by any continued source of irritation of the urinary organs, such as gonorrhea, strictures, or hard living.

Enlargement of the prostate is principally due to fatty degeneration of, with phosphatic deposits in, that organ, the texture of which is usually indurated, though sometimes it has been found to be looser and softer than natural.

The enlargement may occupy the whole of the organ, causing its size to increase to that of a large egg or small orange; or it may be confined principally to the lateral lobes, which may either both or singly become hypertrophied. When this is the case, the urethra becomes greatly elongated and tortuous, winding round the promontories formed by these lobes, and sometimes assuming the form of a sinus, being irregularly dilated; or a complete change may take place, not only in the direction, but in the shape of the canal, which becomes elongated from above downwards into a kind of chink, or, is else flattened out laterally. In all cases of enlarged prostate, whatever be its shape, the corresponding portion of the urethra becomes larger and wider than natural. The elongation of this canal is owing to the general enlargement of the prostate, in which the canal that traverses it must necessarily partake, and its expansion to the outward growth of the organ. So capacious does this portion of the urethra sometimes become, that it may hold two or three ounces of urine, and in consequence of its elongation will carry the neck of the bladder upwards, and behind the pubes to a considerable distance from the surface.

The urethral portion of the prostate may become greatly enlarged in size, with or without accompanying hypertrophy of the lateral lobes. It then usually assumes a nipple-like appearance, but sometimes becomes constricted at the base and expanded above, so as to be truly pedunculated (fig. 339), constituting at last a round and solid tumor overlapping the urethro-vesical orifice. Occasionally the verumontanum alone appears to be affected, forming a kind of thickened valvular projection, which interferes materially with the flow of the urine.

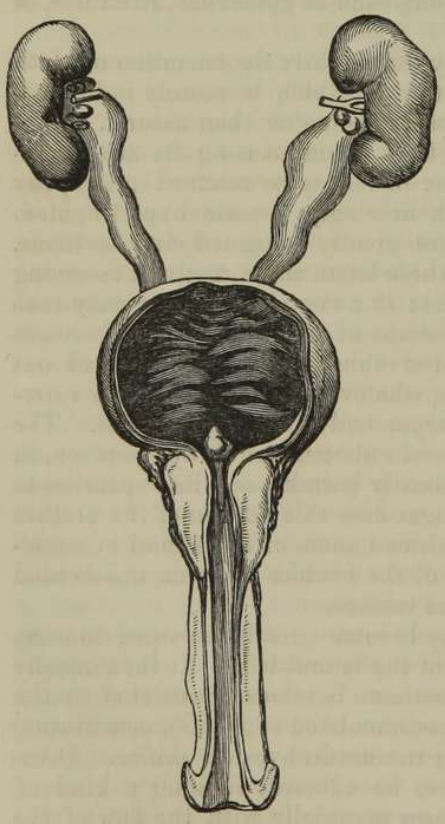
Mr. Thompson has carefully studied the nature of the tumors met with in the prostate. The following remarks embody his observations: "The existence of solid tumors of different kinds is by no means rare in the prostate. They

were pointed out by Sir E. Home, and by him supposed to be of the nature of apoplectic clots. Subsequently they have been regarded as fibrous tumors, and more lately it has been shown that some possess a structure approaching very nearly to that of the secreting tissue contained in the prostatic substance around. It is shown that enlargement of the prostate is very frequently associated with the development, more or less marked, of such growths in some one of three forms; in short, that the production of defined tumor is more frequently than otherwise the essential element of the pathological condition known as hypertrophy of the prostate. Of 14 enlarged prostates 6 exhibited numerous fibrous tumors in the substance of the lateral lobes; the others show polypoid enlargements, single, binary, or multiple, springing from the 'posterior median portion.' The varieties may be briefly noticed as follows: —

"1. A simple fibrous tumor, small, nearly isolated, made up of closely packed organic muscular fibres, with areolar tissue, intimately resembling those found imbedded in the walls of the uterus.

"2. A tumor composed of the same elements as the preceding, but containing, in addition, some of the glandular substance of the prostate, more or less imperfectly developed. This also may be imbedded, with or without a cyst, seeming sometimes to partake more of the character of a local enlargement, limited to a small portion or lobule of the prostate tissue, and only partially isolated. Although separating this class from the previous one for facility of reference, it is more than probable that the two nearly merge into each other at their adjacent limits, the latter approximating to the former by insensible gradations: so that some tumors which appear to be purely fibrous at first may be found to exhibit slight traces, in parts of its structure, of the glandular element. In *all*, however, the basis is *the organic muscular fibre.*

FIG. 338.



"3. A tumor composed entirely of the ordinary structures of the prostate fully developed, and enjoying activity of function in common with the rest of the organ. It assumes a pyriform shape even in its earliest stage, and springs from the posterior median portion. It may vary in size from that of a pea to that of a middle-sized pear. The analogies between these and the polypoid tumors of the uterus are considerable; pointed out by Velpeau and others, modern researches seem to indicate them more plainly."

These enlargements are productive of various inconveniences with regard to the passage of the water, giving rise either to retention or to incontinence, or to a kind of mixture of both conditions. When the lateral enlargements cause the urethra to assume a somewhat tortuous course, the middle lobe, if hypertrophied, may readily occasion retention, by projecting against the entrance to this winding channel. Then again, if the middle lobe continues small whilst the enlargement of the lateral lobes takes a direction up towards the bladder, widening as they go, the vesical neck may be so dilated that incontinence and a continuous dribbling will occur through a kind of fissure that extends between the lateral lobes.

The obstacle offered to the passage of the urine by an enlarged prostate will usually eventually give rise to a chronically thickened, fasciculated, and sacculated bladder, the fundus of which descends below and behind the enlarged gland, forming a kind of pouch that cannot empty itself, and in which mucus and morbid concretions are apt to collect. The ureters often become dilated and the kidneys chronically diseased; a series of changes well illustrated by the preceding cut (fig. 338).

The *symptoms* of enlarged prostate all arise primarily from the mechanical obstacle offered to the passage of the urine. The first symptoms usually consist in the feeling of a necessity to strain slightly before the urine will flow; and then after the bladder has been apparently emptied, the involuntary escape of a small quantity of water. The patient also finds that he is much longer than usual in emptying the bladder, for though the stream flows freely enough so soon as it has once begun to escape, yet it cannot be properly projected, the viscus having, to a certain extent, lost its tonicity. About this time changes begin to take place in the urine, which usually becomes somewhat fetid, though it continues acid, and is often intermixed with more or less viscid, stringy mucus; though in many cases it is clear, pale, and not in any way altered in character. The symptoms often come on in a very gradual manner, the patient straining and experiencing much difficulty in the extrusion of the urine for months or even years before retention will occur. As the disease advances and the bladder becomes less capable of emptying itself, two or three ounces or more of residual urine are left, which becomes dark, mixed with adhesive, sticky mucus; and, at last, if the mucous membrane of the bladder falls into a chronic state of inflammation, assumes a milky appearance from an admixture of pus, and becomes horribly offensive, blackening the silver catheter.

The exact condition of the enlarged prostate can only be ascertained by examination through the rectum and urethra. By rectal exploration with the finger, the degree of enlargement of the lateral lobes can best be ascertained, though as in many cases the end of the finger cannot reach the further extremity of the gland, it will be impossible to say to what extent the hypertrophy has extended. The urethral exploration must be conducted by means of a long gum elastic or a silver prostatic catheter, and will afford information that rectal exploration cannot give; as by it is ascertained approximately the size of the middle lobe, and the condition of the urethra as to elongation and curve.

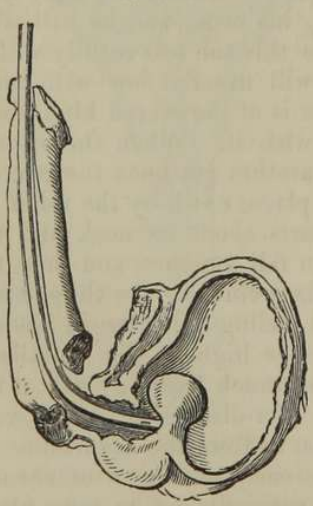
Retention of urine constitutes the great danger in advanced cases of enlarged prostate. It commonly comes on gradually, the patient having for some time before experienced considerable difficulty in passing his urine, and he will often find that the more he strains in his efforts to do this the less readily will it come away; whereas, when he remains quiet, it will usually flow with more freedom. The retention from prostatic enlargement is of the mixed kind, there being always more or less incontinence conjoined with it. When the bladder has become tense, and the prostatic portion of the urethra put upon the stretch, the escape of a certain quantity of urine will take place, until, by the relief of the tension of the over-distended bladder, the parts about its neck and the enlarged prostate become relaxed, so that they again fall together, and thus, the urethra resuming its tortuous condition, the outlet is occluded. In these cases, error may always be guarded against by the surgeon feeling the enlarged bladder rising up above the pubes, and reaching perhaps as high as the umbilicus. This condition is an extremely dangerous one, not so much from any risk of the bladder or urethra giving way in consequence of over-distension, which very rarely happens in retention from enlarged prostate, as from the occurrence of paralysis of the bladder, or the probability of the early setting in of chronic inflammation of its mucous membrane, which is specially apt to take place. The bladder has usually not emptied itself completely for a considerable length

of time before the retention is complete, and a quantity of ropy mucus having collected in the fundus behind the prostate, whence it cannot be expelled, becomes putrid, and thus disposes to the supervention of that form of chronic inflammation of the vesical mucous membrane, which, occurring in a depressed state of the system, is especially apt to give rise to a brown tongue with quick pulse, and typhoid symptoms. Indeed, when death occurs from prostatic disease, it usually takes place in this way.

In the *treatment* of enlarged prostate little can be done by medical means, though the patient's condition may be somewhat ameliorated by treatment calculated to lessen irritation about the urinary organs, and to improve the condition of the urine. With this view, if it be very acid, alkalies with henbane should be given; if neutral or alkaline, the dilute nitric acid with henbane or opium; if mixed with ropy mucus, the infusions of uva ursi or of buchu, and if containing muco-pus, the pareira brava may be administered. If hemorrhage occur, the tincture of the sesquichloride of iron or gallic acid will be useful. Counter-irritation, the application of iodine, and other measures calculated to promote absorption of the enlarged gland, will be found of little service, and are usually productive of serious annoyance to the patient.

In the treatment of enlarged prostate, it is of great importance to use the catheter regularly, in order to empty the pouch that forms in the bas-fond of the bladder behind the prostate; and which being below the level of the urethra, tends to collect an accumulation of viscid mucus and fetid urine which cannot be expelled by the patient's unaided efforts, partly from their gravitating into this pouch, and partly by the muscular power of the organ being impaired. The removal of these matters is of great importance, as, independently of any retention, they may, by undergoing putrefaction, give rise to typhoid infection. The bladder should be effectually emptied *every day*. This may best be done by the introduction of a gum catheter of full size, which should be passed without the stylet, at first once, and then, if necessary, twice in the twenty-four hours. This the patient should be taught to do himself; and thus the habitual distension of the bladder, or retention in it of a quantity of urine, will be prevented, and all the accompanying constitutional disturbance averted. Sometimes in order to empty the bladder thoroughly, a prostatic catheter must be used. This instrument should be made of silver, and be of large size, equal to about No. 12. In order to enter the bladder properly, which is carried away from the surface by the elongated urethra, the prostatic should be about four inches longer than an ordinary catheter; and as the neck of the viscus is usually pushed up high behind the pubes by the projection upwards of the lateral lobes, the curve of the instrument should be greater and longer than usual. I find the best-shaped prostatic catheter to be one, the curve of which is exactly the third of the circumference of a circle five-and-half inches in diameter. The eyes should be large and rounded, and I have found it of use to have the lower end of the stylet provided with a piston plate, so that by withdrawing this, the mucus may be sucked in through the eyes of the instrument. In some cases, however, a moderately curved gum elastic catheter of full size, enters the bladder most easily; in fact, no one curve or one kind of instrument will answer in all cases. In introducing the catheter, care should be taken when the point enters the prostatic portion of the urethra, to depress the handle well between the thighs, lest the end hitch against the enlarged middle lobe (fig. 339), or do

Fig. 339.



not sweep sufficiently round the pubes. So also that it fairly enters the body of the bladder; in enlarged prostate the corresponding portion of the urethra is often elongated and dilated, forming a bend or pouch, containing perhaps half an ounce to one ounce of urine; this the catheter may enter and empty, and the surgeon then erroneously supposing that he has passed the instrument into the bladder, may rest content; but this is a grievous error, as the bladder is left distended beyond this pouch.

When retention has occurred, relief can only be afforded by the proper use of the catheter, and this should never be delayed, as typhoid symptoms in elderly people rapidly set in. Three questions present themselves in connection with the treatment of this form of retention.

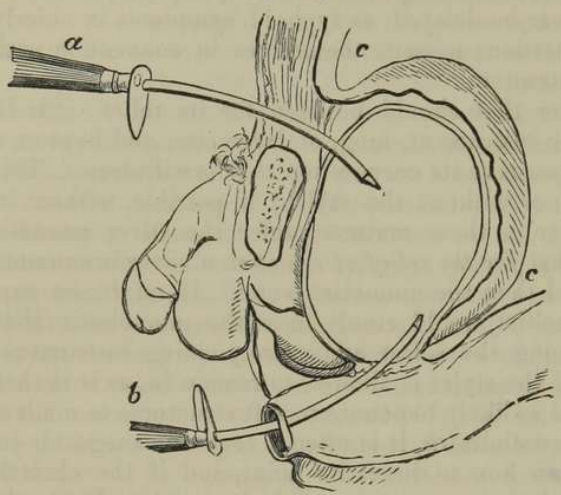
1st. As to the kind of catheter that should be used for its relief. Sir B. Brodie recommends a gum-elastic instrument, long, of large size, and kept on a well-curved iron stylet, so as to preserve its curve when that is withdrawn. This must be introduced either with or without the stylet; if possible, without it. Other surgeons of great authority in these matters prefer the silver prostatic catheter, and I certainly think that *for the relief of retention* a silver instrument is safer, and more easily managed than the gum-elastic one. It might be supposed that a less chance of mischief would result from the gum-elastic than from the metallic catheter, as being the softer and more yielding instrument; but this is, I think, erroneous, if the stylet is allowed to remain in, as it is then as rigid at the point, as hard, and as likely to penetrate soft structures as a silver one would be. If the stylet be withdrawn, it is often a very unmanageable instrument; it is impossible to know how to direct its point, and if the obstacle be a difficult one to surmount, it is not easy to guide it over it. With the metallic instrument, on the other hand, the surgeon can feel his way as it were, and will, if he depress the handle well, as soon as the point enters the prostatic portion of the urethra, find little difficulty in guiding it into the bladder. It is the first introduction of the instrument that especially requires care, and as much gentleness as possible; after it has once been introduced, it will almost invariably readily find its own way.

2d. The next question in connection with the relief of retention in these cases is whether the catheter should be left in the bladder, or be withdrawn after the viscus is emptied. As a general rule, it is certainly far better not to leave the catheter in; its presence in the diseased bladder setting up a low form of inflammation, or giving rise to sloughing of the mucous membrane. The instrument should be introduced twice in the twenty-four hours, and care should be taken if possible to empty the pouch behind the prostate by depressing its point. When the instrument is used habitually in this way, the gum catheter may be employed. Should the mucus be very viscid and offensive, the bladder may be washed out with tepid water through a double current catheter. After the bladder has been emptied for the first time, it will be found to refill in the course of a very few hours, usually in six or eight, the secretion of the kidneys appearing to be set free on the removal of the pressure. Should any great difficulty be experienced in introducing the catheter, it may be thought desirable to leave it in for two or three days, and then a gum-elastic one is always to be preferred, as under these circumstances it presents a great advantage over the silver catheter, becoming soft, accommodating itself to the shape of the parts after the stylet has been taken out, and not being so liable to irritate the mucous membrane with its point, which, dipping down into the pouch behind the prostate, acts as a syphon, emptying this part of the bladder far better than a silver catheter could do.

3d. The third question in connection with the relief of retention from enlarged prostate, is as to the course that should be pursued, if no instrument can be got into the bladder in the ordinary way. In these cases which, however, very rarely occur, two lines of practice may be adopted: either the puncture of

the bladder above the pubes, or forcible catheterism. The puncture above the pubes can very seldom be required. Since the University College Hospital was opened, twenty-one years ago, only one case has presented itself in which it was thought proper to adopt such a procedure. The operation consists in making an incision, about an inch and a half in length, in the mesial line, immediately above the pubes, and then passing a long curved trochar, with its concavity downwards, into the bladder behind that bone, and consequently underneath the reflexion of the peritoneum (fig. 340, *a*). The canula must be left in for the escape of the urine, whilst the continuity of the natural passage is being restored. When the bladder is greatly distended, in consequence of retention from enlargement of the prostate, the peritoneal reflection is carried up with it, and a considerable portion of the anterior wall of the organ uncovered by peritoneum is left above the pubes. In a case of unrelieved retention which I had an opportunity of dissecting, I found that the fundus of the bladder reached to five inches above the symphysis pubes, and two below the umbilicus; that the line of reflection of the peritoneum was $3\frac{1}{8}$ inches above the bone, and that the space uncovered by serous membrane was $2\frac{1}{4}$ inches wide. The bladder contained nearly 40 ounces of urine.

Fig. 340.



a. Puncture above pubes. *b*. Puncture through rectum. *c*. Reflexions of peritoneum.

Puncture through the rectum is not generally a safe procedure in retention from enlarged prostate, in consequence of this structure encroaching on that part of the inferior fundus of the bladder which is uncovered by peritoneum. When, however, the retention arises from enlargement of the urethral portion rather than of the lateral lobes, it may be safely done, and indeed I have known it put in practice with advantage in such cases.

A far safer procedure than this, and one that is recommended by Sir B. Brodie, Mr. Liston, and most surgeons of authority in these matters, is forcible catheterism. As the retention is generally owing to an enlargement of the urethral portion of the prostate, relief may be afforded by pushing the point of a silver catheter through this obstacle into the bladder. A false passage is thus formed, in which the instrument should be left for about forty-eight hours, when it will generally enter it with sufficient readiness on being introduced again.

After the retention has been relieved the bladder will often be paralyzed for a time, the urine flowing out, but with no power of expulsion for some weeks. Under these circumstances the catheter should be used twice in the twenty-four hours; good diet, with wine, quinine and extract of nux vomica may be given, and blisters applied to the sacrum; afterwards the patient should be taught to pass the catheter for himself once or twice daily.

The radical cure of the impediment to the flow of the urine has been proposed to be effected by removing the enlarged middle lobe of the prostate by ligature, by excision with a lithotrite, or by lateral or median incision of the perineum. Such operations, however, from their difficulty and danger, should

not be lightly undertaken; perhaps the least dangerous mode of removal would be by median urethrotomy.

The existence of *malignant disease of the prostate* is of very rare occurrence, and may commonly be ascertained by exploration through the rectum and urethra. The passage, also, of bloody urine, or of clear urine followed by a discharge of blood, mixed, perhaps, with the debris of a cancerous growth will likewise tend to establish the nature of the affection, which is necessarily fatal. The consideration of prostatic calculi will be deferred till we come to speak of urinary concretions generally.

CHAPTER LVII.

DISEASES OF THE URETHRA.

URETHRITIS.

SIMPLE inflammation of the urethra is especially apt to occur in strumous, rheumatic, or gouty individuals, from slight sources of irritation, either direct or sympathetic, that would not excite it in more healthy constitutions. In strumous children, it may arise from worms in the intestines, or from gastric irritation; and in gouty or rheumatic subjects, it appears often to occur in connection with an acid or loaded state of the urine. In other cases, again, the irritation of a stricture, the passage of instruments, or ordinary sexual intercourse, may occasion the disease, without there being anything of a specific or venereal character about it. Women who are out of health, pregnant, or suffering from leucorrhea, may, and often do, give rise to local irritation of this kind. Urethritis, especially when arising from sexual intercourse, is frequently mistaken for gonorrhœa, but from this it may be distinguished by the less intense degree of inflammation, and by the absence of those secondary consequences that so frequently follow true gonorrhœa; but yet, in many instances, the diagnosis is extremely difficult, especially from the subacute forms of gonorrhœa that are so common in London.

The *symptoms* of urethritis consist of heat, pricking, tension about the urethra for a day or two, followed by muco-purulent discharge, often rather profuse, and accompanied by some ardor urinæ. The symptoms altogether are not severe, and the disease usually subsides at the end of a week or ten days, but sometimes it becomes chronic, especially if conjoined with stricture, and then constitutes an extremely troublesome affection, more particularly in gouty individuals.

The *treatment* of urethritis is of a mild, antiphlogistic character. The bowels should be kept open, and salines freely administered; in many cases small doses of colchicum, in combination with alkalies, will be found of especial service in cutting the disease short. The use of emollient, or slightly astringent injections, such as opiate lotions, or a very weak solution of acetate of lead, with belladonna, will be found serviceable as the disease is on the decline, but not until then; and when the affection has got into a chronic stage, small doses of copaiba may be advantageously administered. The diet, in all cases, should be of the blandest character, stimulants of all kinds being interdicted.

If the disease be conjoined with slight stricture, it may not unfrequently give rise to temporary retention of urine. This may, however, most commonly be

readily relieved by antiphlogistic treatment, cupping, or leeches to the perineum, the warm hip-bath, and salines, with, perhaps, opiate suppositories, and plenty of demulcent drinks. The catheter should not be used in these cases, if it is possible to give relief without it.

Urethral abscess occasionally forms as the result of urethritis, a soft fluctuating point being perceived in the neighborhood of the canal. So soon as this is detected, it should be opened, when the aperture that results will readily close. If left, it will probably burst into the urethra instead of externally, the tissues in that direction being less resistant; and then, if it should be opened externally as well, a troublesome urinary fistula will result.

Perineal abscess may form, as the result of urethritis, in whatever way excited, the patient complaining of a sensation of weight, with pain and throbbing, deep in the perineum. On examination, a hard, tense swelling will be found, situated a little anterior to the anus, and extending along the side of the urethra. It presents no sign of fluctuation until it comes forwards into the scrotum. The treatment consists in the application of leeches, followed by fomentations, and an early incision through the perineum into the swelling. In some cases, the abscess is situated altogether external to the urethra, and then the aperture closes readily enough, like that of any other ordinary abscess. In other cases, again, it communicates with the canal, and then fistulous openings are left through which a certain quantity of urine escapes. These apertures gradually tend to close if they be not complicated with stricture or other urethral disease; should they be so, they will require special treatment, of a kind that will be mentioned at a later period.

GONORRHEA.

Gonorrhea is a specific disease accompanied by inflammation, and an abundant muco-purulent discharge, affecting the urethra most commonly, but also the other mucous membranes of the genital organs, as of the prepuce and the glans in the male, and of the vulva and vagina in the female.

The urethra is the usual seat of gonorrhea in the male, and the disease may be looked on as a specific urethritis, which is usually fixed with greatest intensity in the fossa navicularis; but it may extend itself over a much wider surface, affecting the entire length of the canal, and extending over the whole mucous lining of the bladder. In the female it commonly spreads over the extensive mucous surface of the internal organs of generation, and sometimes even invades the uterus.

Gonorrhea is a truly specific and a highly contagious affection, arising in all cases from the application of a peculiar animal poison, generated by impure or indiscriminate sexual intercourse, to the parts which it attacks, and must not be confounded with the various non-specific inflammatory diseases that may affect the parts commonly the seat of gonorrhea, and which are all characterized by muco-purulent discharges.

The poison of gonorrhea differs entirely from that of syphilis, as has been fully proved by the unerring test of inoculation; these diseases not being capable of reproducing one another under any circumstances.

Gonorrhea is usually looked upon as a purely local affection of the genital organs. Some surgeons, however, amongst whom may be especially mentioned Mr. Travers, seem to consider it as occasionally assuming a constitutional character; in this opinion I entirely agree. Although the gonorrhea in the early stages is doubtless a strictly local affection, yet there is a particular train of phenomena occasionally following it of a very characteristic nature, that can scarcely be looked upon in any other light than as being the result of constitutional infection, the more so as they are very apt to occur in some individuals who never have gonorrhea without the disease being followed by these sequences,

whilst others are altogether exempt from them. The parts that are secondarily affected are chiefly the fibrous tissues, the mucous and the cutaneous surfaces The affections of the fibrous tissues give rise to rheumatism, and the peculiar forms of inflammation of the testicle and of the sclerotic. The affection of the mucous membrane displays itself in specific inflammations of the throat, and of the eyes; and the skin becomes the seat of certain eruptions. The occurrence of these various affections, assuming as they do a specific type so distinctly marked that they can at once be characterized as gonorrheal, certainly tends to show that the disease impresses the constitution in some peculiar manner something analogous to, though in a far minor degree, and with much less certainty, than syphilis.

The *symptoms of gonorrhea in the male* may be divided into three stages:— 1st. The incubative stage, or the period of irritation; 2d. The acute; and 3d. The chronic inflammatory stage.

The first stage, that of irritation, usually comes on from three to five days after connection, when the patient begins to experience some degree of heat, itching, and general irritation about the penis. The lips of the urethra are somewhat red and swollen, its orifice gaping, and on squeezing it some muco-pus exudes. This stage usually commences about the time mentioned, but sometimes sets in immediately after connection; and in other instances does not occur for eight or ten days; after lasting for twenty-four or forty-eight hours it terminates in the second stage, which is one of active inflammation. The discharge now becomes abundant, thick, and of a greenish-yellow color; there is great pain in making water, with considerable heat and smarting, and the urine flows in a diminished stream, but is passed with increased frequency. The urethra is swollen, firm and cord-like to the touch; the whole penis, indeed, looks generally red and turgescent. As the disease advances, and the bulbous portion of the urethra becomes affected, tension in the perineum will be complained of. If the prostatic portion is the seat of disease, there will be heat and weight about the anus. During the whole of this period there is generally a good deal of constitutional disturbance, restlessness, and fever.

One of the most troublesome symptoms in this stage of the complaint is the occurrence of *chordee*, which consists in painful erections at night, with a twist in the body of the penis, which is usually curved down towards the scrotum.

These symptoms usually continue for about a fortnight, when the third stage, that of subacute or chronic inflammation, sets in; during this period of the affection the inflammatory symptoms gradually subside, but a thin muco-purulent discharge keeps up, with some degree of heat and irritation about the urethra, and occasional smarting in making water; under proper treatment this usually subsides in the course of another fortnight or three weeks; but if neglected, or in certain constitutions, it may last for many months, or even years, then degenerating into a *gleet*. In proportion to the continuance of the affection the inflammatory symptoms subside, though the specific and contagious character does not disappear, and the infection may continue so long as the discharge keeps up. Hunter mentions the case of a girl who had been two years in the Magdalen Hospital, and who infected a person with whom she had connection immediately after she left that institution. The persistence of the contagion of gleet is, it is true, more marked in women than in men. So long, however, as any discharge continues from the male urethra the patient must be looked upon as infectious.

The severity and the continuance of gonorrhea are often opposed to one another. Thus the disease is most severe in young and plethoric persons, and in first attacks; but it is most difficult of cure in strumous and phlegmatic constitutions, more especially if there be a gouty or rheumatic tendency co-existing, and is very troublesome to remove after repeated attacks. I have observed

repeatedly that it is very apt to degenerate into a gleet in those people who are subject to chronic diseases of the skin.

The length of time that the infection of gleet will continue in both sexes, but especially in the female, makes it somewhat difficult to say whether the poison of gonorrhea can be generated *de novo*, as it is not improbable that many individuals communicate the disease, believing themselves to be perfectly cured, though still suffering from slight gleet.

The *treatment* of gonorrhea must be conducted with reference to the stage to which the disease has attained, but especially with regard to the amount of inflammatory action accompanying it. It is of two kinds, *rational*, and *specific* or *empirical*. Both plans are useful, and, indeed, usually necessary for a proper cure, but they cannot be adopted indiscriminately. Thus, if specific means are employed during the acute inflammatory stage of the complaint, much mischief may ensue; whilst if antiphlogistic treatment is persevered in for too long a time, the disease may be kept up indefinitely.

It has been proposed to adopt what has been termed the *abortive* or *revulsive* treatment, during the earliest stages of gonorrhea; indeed, during the incubative period. This method consists either in the injection of a very strong solution of the nitrate of silver into the urethra, or the application to the inflamed mucous membrane of a strong ointment of that salt by means of a bougie smeared with it; other surgeons, again, have recommended the administration of very large doses of copaiba at this period. These various plans have, however, I think, deservedly fallen into disrepute. I have on several occasions seen most intense inflammation excited by these modes of treatment, and never, in any case, any good result. Independently of this, it is impossible to know whether the case, in the earliest stage, will prove to be one of simple urethritis or a specific gonorrhea.

In the acute inflammatory stage, attended by heat, swelling of the organ, great ardor urinæ, and abundant muco-purulent discharge, the treatment must be entirely antiphlogistic, the activity of the measures being proportioned to the intensity of the inflammation. If this be of a very severe character, leeches may be applied to the perineum, or to any very tender point along the urethra. If not so intense, warm hip-baths, poppy fomentations, or the envelopment of the penis in warm-water dressing, will be of essential service. At the same time the urine must be diluted, and its acidity lessened by the patient drinking large quantities of alkaline diluents,— barley-water or linseed tea containing a little nitre or carbonate of potass in solution, or soda-water; and the skin and bowels may be kept in action by the administration, every fourth or sixth hour, of a powder composed of ʒj of sulphate magnesia, 5 grains of nitre, and $\frac{1}{12}$th of a grain of tartar emetic, dissolved in a wine-glass of water. All stimulants must be avoided, the diet being restricted to light slops, and perfect rest enjoined. By such means as these, the activity of the inflammation will be gradually lessened, the discharge becoming thinner, the smarting in making water not so severe, and the erections less painful. The patient should also be desired to pass his water frequently, so that it may not be too concentrated.

When this the second stage of the disease has been reached, specific treatment may be employed with great advantage, which, if it were had recourse to at an earlier period, would certainly have increased the inflammatory action and given the patient much distress. At the same time the specific remedies, such as copaiba and cubebs, must be cautiously given, even in this stage; the surgeon feeling his way with them, and being prepared to discontinue them and to return to strictly antiphlogistic measures, if he finds that they increase the irritation. Should the disease, however, from the commencement, have assumed a subacute character, the specific treatment may with safety be adopted at a much earlier period.

Copaiba and cubebs are the remedies that are almost universally had recourse

to in this stage of gonorrhea. Of these copaiba is the least irritating, and consequently most generally to be preferred. It may be administered in a variety of ways, in capsule, pill, draught, or extract. In capsule it is generally to be preferred, on account of the nauseous taste being thus more readily disguised; but in many cases it acts with more certainty, and with better effect, if given in either of the other forms. When the capsules are given, the patient may take from six to eight or ten in the day, and should at the same time have an alkaline mixture, which increases materially the effect of the drug. A very excellent mode of administering copaiba is to rub it down into a mass with burnt magnesia, and to let the patient take about ʒj of this paste three times in a day, in a bolus wrapped in wafer-paper; or, if the taste is not much objected to, he may take it most advantageously in mucilage, with liquor potassæ and tincture of henbane.

In some relaxed constitutions, and more particularly after frequent claps, cubebs will be found to cure the patient more readily than copaiba, or rather most successfully, if given in combination with it. An excellent plan is to put about half an ounce of the powdered cubebs into a mortar, and to rub it up with as much copaiba as will form a stiff paste, of which the patient should take ʒj as a bolus thrice daily. The effects of this electuary are often most striking, but it can only be used in the constitutions indicated, and after the more active inflammatory symptoms have subsided.

It is during the second stage of gonorrhea that injections may advantageously be used. Much and very unfounded prejudice exists against their use in the minds of many; but surely it is as safe to apply proper local applications to an inflamed urethra as it is to an inflamed conjunctiva; and the bad consequences, such as a stricture and inflamed testicle, which have sometimes been referred to their use, have rather been due, either to the long continuance and to the severity of the disease itself, than to the remedies employed, or to their application at too early a stage, or of too great a strength. It is in long standing cases of gonorrhea, in which the discharge continues for months or years, that stricture results, not in cases of ordinary duration; and in these it is the result of the chronic inflammatory thickening of the mucous membrane, and has no more to do with the injections than with the copaiba or salines the patient may have taken. As the ardor urinæ subsides, emollient and slightly astringent injections may be used. The best are perhaps the acetate of lead in tepid water, of the strength of two grains to the ounce. If this induce irritation, a few grains of the watery extract of opium may advantageously be added. As the disease subsides, a stronger astringent is required, and then one or two grains of the acetate of zinc may be added to each ounce of the injection; or a very weak solution of the sulphate or chloride of zinc may be employed, gr. ij of the first, and gr. ½ of the second to each ounce of water; or an injection of gr. ¼ of the nitrate of silver to the ounce may be used. During the whole of this stage the diet and habits of life must be carefully regulated, and all stimulants interdicted. The injections should be discontinued as soon as the discharge has ceased; unless this be done they may re-induce it.

The mode of injection is of importance. A glass syringe should always be used, with a smooth, rounded nozzle. The patient sitting on the edge of the chair and holding up the penis, should carefully insert the end of the syringe between the lips of the urethra, and then slowly throw in the injection as far as it will go. Although the inflammation is usually confined to the anterior portion of the urethra, yet it may extend to the bulb, and the injection should be applied to the whole length of the inflamed mucous membrane. If any enter the bladder it cannot signify, as it will immediately be decomposed by the salts and mucus of the urine.

In the third stage of gonorrhea, that of gleet, much difficulty will often be experienced in curing the patient of his discharge. Here much depends not

only on the administration of proper remedies, but in care being taken attentively to regulate his habits of life. It will constantly be found that after the disease has apparently been cured, excesses at table, and more especially the drinking of beer, effervescing or acid wines, will bring back the discharge. So also it will return after connection, though it had previously ceased entirely This is especially the case in those constitutions that are either strumous, gouty or rheumatic, and in which all urethral inflammations are with difficulty removed. In these cases, then, abstinence from all stimulants, dietetic as well as alcoholic, and improvement of the tone of the system by change of air, sea-bathing, &c., will often be of essential service. At the same time, the electuary of cubebs and copaiba, or one composed of cubebs and the sesquioxide of iron, may be administered with advantage. In other cases again, especially in relaxed constitutions, the tincture of the sesquichloride of iron, alone or conjoined with a few drops of spirits of turpentine or tincture of lytta, will be found productive of much advantage.

In chronic gleets, local applications will be found to be necessary for the cure of the disease. Amongst these I have found none more useful than one composed of ten grains of the chloride of zinc and one scruple of gallic acid to eight ounces of water. In some cases the nitrate of silver injections, of the strength of half a grain, or the bichloride of mercury, in the proportion of a quarter of a grain to the ounce, will be serviceable. And indeed in most instances it is beneficial to vary the injections, the mucous membrane appearing to get accustomed to the same stimulants after a time, and thus not being impressed by it in a proper manner,

After the gleet has continued for some months, more benefit will often be derived from the introduction of a full-sized metallic bougie every second or third day than by any other local means, even where no stricture exists. The instrument should be left in for about ten minutes, and should be of the largest size that the urethra will admit.

COMPLICATIONS OF GONORRHEA.

Gonorrhea when acute or virulent seldom runs its course without local complications of some kind, the result of the propagation of the inflammation to neighboring parts, often of considerable severity, and occasionally even hazardous to life;—such as chordee, phymosis, sympathetic bubo, abscess in perineo, irritability of the bladder, retention of urine, hemorrhage from the urethra, &c. Many of these complications present no special features, but require to be treated on general principles, without reference to their specific cause. Others, again, demand more special management, and these we may briefly consider here.

The *chordee*, or painful erection of the penis, with twist of the organ, coming on at night, is often a most distressing and troublesome symptom. It is usually best relieved by the application of cold to the part, but more especially by the administration at bed-time of a pill composed of gr. j of opium to gr. v of camphor, the camphor acting as a direct sedative to the generative organs. Ricord recommends a suppository of camphor and opium, gr. x of camphor, and gr. j of the watery extract of opium, to be introduced into the rectum an hour before bed-time, as the best means of removing the tendency to chordee.

The *irritability of the bladder with spasm of the neck and dysuria* may be of two kinds, either *inflammatory*, — coming on in the earlier stages of the disease with pain in the perineum, and all the symptoms of active inflammation about the part strongly marked; or *atonic*, — supervening at a more advanced period, without any special signs of inflammation. In the first case leeches to the perineum, hot poppy fomentations, the warm bidet, with full doses of Dover's powder, or of henbane and carbonate of potass or nitre, will probably afford much relief. When the disease is *atonic*, the administration of the tinc-

ture of the sesquichloride of iron, conjoined with local soothing remedies, as the poppy fomentations or bidet, and an opiate suppository will be beneficial.

In *retention of urine* from gonorrhea the obstruction is usually dependent on a congested and inflammatory condition of the mucous membrane of the urethra. In these cases, leeches to the perineum, the warm hip-bath, and opiate suppositories will probably afford relief. It is always desirable to avoid using the catheter, as it is apt to lacerate the swollen and softened mucous membrane and thus to occasion troublesome bleeding; and will always be productive of much pain, and of increased irritation of the canal. Should, however, the retention have continued twenty-four hours, or longer, it may most probably not give way by the means above indicated, and then it will be necessary to use the instrument, when a full-sized silver one should be very carefully introduced; a large instrument entering the bladder as easily and with less risk of injury to the tender walls of the canal, than a smaller one.

When once the catheter has been introduced, it is often a somewhat difficult matter to determine whether it should be left in or taken out. If it is left in, inflammatory action is increased. If it is taken out, it may not be got in again. The solution to this question is to be found in the facility with which the instrument is passed. If it has been introduced without much difficulty, it is better to withdraw it after the bladder has been emptied, and to continue the antiphlogistic treatment, when a second introduction may not be required. If, on the other hand, the catheter has been passed with great difficulty, and is firmly grasped either by spasm or stricture, it should be left in; but very active treatment must be employed to prevent its exciting too much inflammation.

It must, however, be remembered that the retention may be due to more serious conditions than this; to prostatitis, to abscess in that gland, or in the perineum, or to inflammatory exudation in the tissues about the neck of the bladder. Under these circumstances, more active antiphlogistic measures will be required, with the use of the catheter twice in the twenty-four hours, and probably free incisions into the perineum, if there be pus or urine extravasated into that region.

In many cases also of gonorrheal retention, there is an old stricture as well as the clap. Here the employment of energetic antiphlogistic measures, with the use of the catheter are indicated, but as the stricture is the chief cause of obstruction the treatment must be directed to it.

Hemorrhage from the urethra may occur either as the result of chordee, and consequent rupture of some blood-vessels of the mucous membrane, as the consequence of attempts at passing the catheter, or as a kind of exudation from the mucous membrane. Most commonly it may be arrested by the application of cold, and the employment of moderate local antiphlogistic treatment. Should it be abundant, pressure by means of a bandage to the penis or perineum, and the introduction of a large gum-elastic catheter will arrest it.

SEQUENCES OF GONORRHEA.

The sequences, or more remote complications of gonorrhea, are partly local and partly constitutional. Amongst the local, we find more particularly warts about the prepuce and glans or within the urethal orifice, which require to be treated by excision or caustics; and stricture, the management of which is fully described elsewhere. In some cases, also, in consequence of extravasation of blood, or the effusion of plastic matter into the corpus spongiosum or the corpora cavernosa, limited and localized induration and thickening of the penis may result, attended by chordee, painful erections, and a permanent twist in the organ. In such conditions as these absorption of the effused mass may be attempted by the administration of small doses of the bichloride of mercury; with the inunction of the iodide of lead ointment.

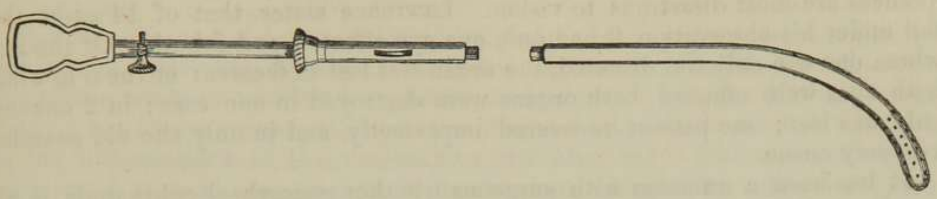
After the cure of a clap that has been of long continuance, the generative organs are often left in a weak and irritable state; the penis, scrotum, and spermatic cords being lax and elongated, with an apparent want of power, and often painful and dragging sensations about the cords and groins. In some of these cases the patient loses the power of erection, emission taking place before erection, and thus preventing proper connection. In other instances, again, erection of the penis takes place, but is immediately followed by emission; and in some cases, although erection occur, the expulsive power seems to be lost, and the semen, though escaping through the ejaculatory ducts, is not properly ejected, but either flows back into the bladder, or slowly escapes after the erection has gone down. Besides these various morbid states, nocturnal emissions are common, especially after slight derangement of the digestive organs and of the nervous system; and viscid prostatic fluid is not uncommonly squeezed out after the escape of the urine, or during defecation. These various morbid conditions are commonly confounded with spermatorrhea, which they closely resemble, and constitute different forms of *impotence*. They require careful consideration on the part of the surgeon, as their existence is a source of the greatest mental depression and distress to the sufferer; certainly one cause of conjugal infidelity, and occasionally, I believe, of suicide. These affections, which are of extreme frequency amongst all classes of the community, have scarcely as yet received that attention on the part of the profession generally that their importance deserves, and the unfortunate sufferers from them are too often driven into the hands of those pestilent quacks that flourish in the metropolis, and now infest almost every town in the country, and by whom they are not unfrequently ruined in health as well as in purse.

These various forms of *impotence*, of *spermatorrhea*, of *debility of the generative organs*, or by whatever other name the condition may go, are frequently difficult of cure, on account of the ready way in which they are influenced by moral causes; and the hypochondriacal state into which a patient laboring under them usually falls, makes it of much importance to speak cheerfully, to hold out hopes of a speedy recovery, and to endeavor to divert the patient's mind from dwelling constantly on his infirmity. He should also be cautioned not to attempt to have connection during treatment, lest the occurrence of failure should dispirit and depress him still more.

The curative treatment of these cases should consist in giving tone to, and in lessening the irritability of the genito-urinary organs. The first object is obtained by the administration of the tincture of the sesquichloride of iron, but more especially by the habitual daily use of the cold hip-bath. This the patient should use every night and morning, remaining in it, at first, for about three minutes, but gradually increasing the time of immersion to ten or fifteen. In some cases, the cold shower-bath appears to give more tone, and then should be preferred. These means, useful as adjuncts, will not however cure the patient. For this purpose, the local irritability must be removed, by the application of the nitrate of silver to the prostatic and bulbous portions of the urethra. It will usually be found that there is a good deal of tenderness in these situations, felt by pressing upon the perineum, or by passing an instrument into the urethra, when, as the point enters the bulb, the patient will usually suffer much pain. The continuance of this irritation certainly keeps up the nocturnal emissions, and thus maintains the debility of the genital organs, and the nervous irritability that is so characteristic of these cases. It may most effectually be remedied by the application of the nitrate of silver, as originally recommended by Lallemand; and if this is done in a proper manner, a cure will usually be accomplished. Of late years I have employed, with much advantage in such cases, the instrument here figured (fig. 341). It consists of a silver catheter, having about a dozen minute apertures near the end. In the interior is contained a slender piece of sponge, about two inches long, fixed to the expanded

end of a firm stylet that moves within the catheter. The instrument is charged by filling the sponge with some solution of the nitrate of silver by withdrawing the stylet. It may then be well oiled, and being passed down to the spot to be

Fig. 341.



cauterized, the solution is forced out of the aperture, by pushing down the rod, which compresses the sponge. I have found this syringe-catheter far safer and more manageable than Lallemand's or any other porte-caustics that act by protruding a spoon or sponge, which is apt to be grasped by the spasmodic action of the muscles of the part, often being returned with difficulty into the shaft, and not without risk of lacerating the mucous membrane. I generally use a solution of the strength of ʒj of the nitrate to an ounce of water, though sometimes only a half, or a third of this strength can be borne. The application usually occasions a good deal of irritation for a time, sometimes even a muco-purulent discharge, and can only be repeated at intervals of from ten days to a fortnight. Any undue amount of irritation must be subdued by ordinary antiphlogistic treatment.

Besides these strictly local complications of gonorrhea, a certain set of sequences to which some constitutions are especially liable, occasionally occurs as the result of this disease, viz., inflammation of the testes and of the eyes, rheumatism, cutaneous eruptions, and sore throat. Some of these, as the affections of the eyes and testes, may either be local or constitutional; the others are clearly constitutional.

Gonorrheal inflammation of the testis, is certainly the most common of these sequences. It almost invariably affects only one testis, and commences in the epididymis, whence it extends to the body of the organ. It usually occurs in those individuals who have a lax and long scrotum, with very pendulous testes. It seldom sets in before the third week after the occurrence of the gonorrhea, but may occur at any period during the continuance of the discharge, though it is more frequent between the fifth and sixth weeks than at any other time. In cases of gleet, also, it not uncommonly occurs at a later period. In many instances it is referred to some slight injury — a blow, or squeeze, received during the continuance of the gonorrhea; but, in other cases, it would appear to arise from extension of the inflammation along the ejaculatory duct; and in others, again, to a kind of metastasis of the morbid action from the urethra to the testis. The fact of the disease commencing in the epididymis may be advanced in support of the first opinion; whilst the fact that the discharge usually ceases when the inflammation of the testicle comes on, and returns as it subsides, may be adduced in support of the doctrine of its metastatic origin. As the symptoms and treatment of gonorrheal inflammation of the testicle present nothing peculiar, I shall reserve their consideration until we come to speak of diseases of this organ.

Gonorrheal inflammation of the eyes is fortunately not of very common occurrence. It may affect either the conjunctiva or the sclerotic.

Gonorrheal conjunctivitis is one of the most destructive forms of ophthalmia, giving rise, not unfrequently in the course of forty-eight hours, to the most intense chemosis, with opacity and softening of the cornea, followed by staphyloma and a discharge of the humors. In the majority of instances only one

eye is affected, but in some, both are involved to an equal extent. The disease commences with the ordinary symptoms of conjunctival inflammation; itching and swelling of the eyelids, velvetty redness of the conjunctiva, muco-purulent discharge, with much lachrymation. The chemosis sets in early, and is of a very severe character, and unless treatment affords speedy relief, the consequences are most disastrous to vision. Lawrence states, that of 14 cases that fell under his observation, 9 had only one eye affected, and 5 both. Of the 9 in whom one eye only was diseased, the organ was lost in 6 cases; of the 5 in whom both eyes were affected, both organs were destroyed in one case; in 2 one eye only was lost; one patient recovered imperfectly, and in only one did complete recovery ensue.

It has been a question with surgeons whether gonorrheal ophthalmia is the result of the direct application of the specific pus to the conjunctiva, or occurs as a constitutional disorder. There can be little doubt that the application of the pus to the surface of the conjunctiva might occasion the disease, but at the same time it is perfectly certain that in many instances there is no evidence of contact; the inflammation occurring in both eyes without the patient having apparently communicated it; and though it is necessarily difficult to adduce positive proof on this point, it is but reasonable to presume that such cases may be constitutional.

The *treatment* of this dangerous affection must be of an active character; blood should be taken freely from the temples by cupping, or if the patient is sufficiently robust, from the arm, as strongly recommended by Lawrence, who places great reliance on it; he must of course be kept in a dark room, and on a strict antiphlogistic regimen. The disease must, however, be met, and the eye can alone be saved by active local treatment. The most active topical agent that we possess is the nitrate of silver. The use of this astringent, originally introduced by Littell, has been much insisted on by Guthrie, Walker, and others, and is generally adopted at the present day, being certainly the most useful agent that we possess. Surgeons differ somewhat in opinion as to the strength of the application; some, the Germans especially, advise that the solid stick should be used, whilst others employ it in solution, of the strength of a drachm to the ounce of distilled water; Mr. Wharton Jones employs a weaker solution, one of four or five grains to the ounce, and I have seen cases very successfully treated by this plan; so much so, indeed, that I should be disposed in future to adopt it in preference to the stronger solution. A few drops must be introduced about twice in the twenty-four hours, into the inner canthus of the eye; the lids between times being kept covered by compresses dipped in weak alum lotion, and the purulent discharge carefully washed away as it accumulates, by the employment of tepid alum injections. In doing this, great care must be taken that none of the discharges come in contact with the eyes of the surgeon or nurses, as it is of a highly contagious character, and will almost to a certainty reproduce the same disease; and instances are recorded in which, in this way, the attendant's vision has been destroyed. If the chemosis be considerable, it must be incised, and as the inflammation subsides, belladonna lotions may be employed with advantage, and the use of the nitrate of silver gradually discontinued.

Gonorrheal sclerotitis is by no means of such frequent occurrence as the conjunctival inflammation; when it happens it will commonly be found to be associated with gonorrheal rheumatism, and not unfrequently with inflammation of the testicle, occurring apparently in those individuals in whom there is a tendency to affection of the fibrous tissues. This disease is evidently of constitutional origin, as it cannot possibly arise from local contagion; it is attended by the ordinary signs of sclerotic inflammation, and is usually accompanied by some degree of iritis. In the treatment there is nothing very peculiar, cupping or leeches to the temples, with belladonna fomentations, are the principal

local means, and calomel and opium, continued until the gums are affected, constitute the chief elements of the practice to be pursued, and must be persevered in until the anterior chamber clears, and any effused lymph is absorbed. As the disease declines, and especially if the patient is somewhat debilitated, soda, rhubarb and bark in powder may be given internally, and blisters kept open on the temples.

Inflammation of the nose, attended by profuse suppuration, is a complication that I have more than once had occasion to observe in gonorrhea. The swelling of the organ is considerable, the tenderness great, and the discharge abundant; a condition, indeed, of the Schneiderian membrane that seems analogous to the inflammation of the conjunctiva just described. The treatment that I have found succeed best consists in fomentations followed by astringent lotions or injections.

Gonorrheal rheumatism principally occurs in young, florid, and otherwise healthy men. It is of two kinds; in one, the most common, and indeed the typical variety, the fibrous and muscular structures are affected; in the other, the joints are implicated. The fibrous or muscular form of rheumatism is not infrequently associated with inflammation of the testicle or the sclerotic. It commonly affects the fleshy parts of the body, as the hips, the shoulders, and the thighs, and not infrequently occurs in the soles of the feet. It is always painful at night, but is not commonly attended by any very severe constitutional disturbance. The synovial form presents the ordinary characters of rheumatism of the joints, the knees and ankles being those chiefly involved. In the treatment of these affections, calomel and opium, or Dover's powder with colchicum, must constitute the most important elements until the acute stage is passed, when the iodide of potass may be advantageously given.

Cutaneous eruptions chiefly consisting of roseola, with slight pityriasis, and perhaps a few patches of psoriasis with very flimsy scales, occasionally occur in rather severe cases of gonorrhea, usually appearing from six weeks to three months after the commencement of the attack. They are chiefly diffused about the chest and belly, and present no sign of coppery redness. At the time of their occurrence, the fauces commonly become similarly involved, presenting, as was first pointed out by Travers, a diffused superficial redness on the velum palati and pillars, with perhaps superficial ulceration on these, the tonsils or the uvula. The occurrence of these affections is usually preceded by slight febrile action, which, however, subsides on their full evolution. Those roseolar eruptions, occurring during gonorrhea, have occasionally been attributed to some peculiar influence exercised by the copaiba, but I think not on sufficient evidence. I am not aware that copaiba, when administered for other diseases than gonorrhea, ever produces such eruptions, and they will occur, as I have seen in several instances, when no copaiba is being given. The treatment of these affections should consist in the administration of salines, followed by the iodide of potass in small doses. Mercurials are never required.

Gonorrhea in the female differs from the same affection in the male in not being so severe, though it is usually more extensive, and of longer duration. The severity is less, on account of the shortness of the female urethra preventing the occurrence of the retention of urine as in the male, and also from the absence of such parts as the prostate, testes, &c., the implication of which constitutes the principal source of difficulty in men. Gonorrhea in the female may affect the part to very different degrees; thus the vulva alone may be implicated, or, as most commonly happens, the inflammation may spread to the whole of the mucous membrane of the vagina. The urethra is less commonly the seat of disease, though occasionally implicated with other parts; and, lastly, the interior of the uterus may become affected by this specific inflammation. In some cases even, it will spread along the Fallopian tubes to the ovaries, and I have known

one or two cases in which rather acute attacks of peritonitis, probably induced in this way, have complicated this disease.

The *symptoms* of gonorrhea in women are sufficiently well marked in the early stages, where there is an abundant muco-purulent discharge from the parts affected, with a good deal of inflammatory irritation about them, accompanied with pain in micturition, and a frequent desire to pass water. As the disease becomes chronic, however, it is more difficult to determine its true character; it being apt to be confounded with some of those accidental and leucorrheal discharges to which females of all ages are subject.

In the majority of cases, gonorrhea may be distinguished from all other muco-purulent discharges of the female organs by the presence of inflammation about the external parts, the mucous membrane of the vagina and urethra. In these cases it will be found, on introducing a speculum, which, however, occasions considerable pain, and is firmly grasped by the contraction of the vagina, that the discharge comes from the wall of this canal, and that the uterine orifice is free or nearly so from it; whereas, in leucorrhea the discharge proceeds in a great measure from the interior of the uterus, the os and cervix of which would probably also present signs of diseased action. It must, however, be borne in mind that the discharge in gonorrhea may occasionally be in a great degree uterine; and that that of leucorrhea may be an exudation from the mucous membrane of the vagina. Under such circumstances, when the disease is chronic, it is almost impossible to arrive at a correct conclusion as to the nature of the case from simple inspection; and in these cases of doubt, the surgeon had better give a very guarded opinion, lest he be led into the error of inculpating an innocent woman. The difficulty is increased, and a good deal of obscurity thrown over the case by the fact that leucorrheal discharges will occasionally give rise to urethritis in the male, which closely simulates gonorrhea. Children also are occasionally subject to an acute inflammation of the vagina and nymphæ as the result of simple irritation, of constitutional disturbance, or of teething; these cases require to be recognized, as they have frequently been the cause of unfounded accusations.

The *treatment* of gonorrhea in the female must vary according as the disease is acute or chronic. In the acute stages, general and local antiphlogistic means must be had recourse to—salines, low diet, rest in bed, and emollient sedative fomentations. As the disease subsides into a chronic condition, astringent injections must be employed; a weak solution of the acetate of lead, or the liquor aluminis comp. largely diluted with tepid water, being especially useful. In other cases again, a weak solution of the nitrate of silver may be used with much advantage. These injections should be employed three or four times a day, and in large quantity. After they have been thrown up, a piece of lint well soaked in the lotion should be introduced between the opposed mucous surfaces, so as to prevent their coming into apposition, the discharge being in a great measure kept up by their friction against one another. In order that the injection be properly given, the woman should lie flat upon her back, and pump in the fluid by means of one of Kennedy's elastic bottles. In the treatment of gonorrhea in women, specifics are of no use unless the urethra be affected, when copaiba may be given, as in the male. The disease is apt to degenerate into a chronic, gleety condition, leaving a thin, muco-puriform discharge, which will continue to be infectious for a great length of time.

STRICTURE OF THE URETHRA.

Much discrepancy of opinion has for a long time existed as to the structure of the urethra, some surgeons admitting, others denying its muscularity. Though the presence of muscular fibres in the urethra had been suspected by many in consequence of the phenomena presented by some forms of stricture

being solely explicable in this way, it is only very recently that their existence has been demonstrated; Kölliker and Hancock having shown that the tube is surrounded through its entire length with an organic muscular coat. Hancock has demonstrated the course of these fibres. He has pointed out that the fibres of the inner layer of the muscular coat of the bladder pass forwards underneath the mucous membrane of the prostatic portion of the urethra, and those from the outer layer of the muscular coat of the bladder outside the prostate. These two layers join at the membranous portion of the urethra, forming the muscular covering of this portion of the canal. At the bulb these two layers divide again, the inner, lying underneath the mucous membrane, separated from it merely by cellular tissue; the external, lying outside the corpus spongiosum, between it and its fibrous investment; at the anterior extremity of the urethra they unite again and form its lips. Thus the urethra is surrounded through its whole length by muscular fibres, a double layer of which invests it at the membranous portion, and again at the external meatus. The prostate and corpus spongiosum are included between planes of these fibres. The vesicles and ducts of the prostate are surrounded by layers of organic fibre; those of the ejaculatory ducts coming from the organic layer of the vas deferens. These fibres are totally distinct from the common muscular apparatus of the perineum, and their existence proves the urethra to be, what had often been suspected, a musculo-membranous canal.

By *stricture of the urethra* is meant a narrowing of the canal at one or more points. This may proceed from three distinct conditions; viz: — 1st, spasmodic action of the layer of the organic muscular fibres situated outside the mucous membrane; 2d, congestion of the mucous membrane of the canal; or, 3d, organic changes in the mucous and submucous tissues, consisting of thickening, induration, or the deposit of plastic matter within them. According as the disease arises from one or other of these causes it may be termed a *spasmodic*, a *congestive*, or an *organic* stricture. These different forms of the disease having the one condition, narrowing of the urethra, and its consequences in common, and in practice being often associated together, present so much variety in their symptoms, in the treatment they require, and in the constitutions in which they occur, as to require separate description.

1st. *Spasmodic stricture.* — The existence of this form of the disease has been much cavilled at; surgeons disregarding the evidence of their own senses, and being led away by an imperfect anatomical examination of the urethra, denied the possibility of spasm of this canal, not being able to demonstrate the existence of any muscular fibres in sufficiently close proximity to the mucous membrane to influence it by their action. The possession of muscular contractility by the urethra is, however, obvious from the facts that a bougie may occasionally be introduced with sufficient ease, but that the surgeon on attempting to withdraw it, will find it tightly grasped: so also occasionally on introducing the instrument he will feel it meet with an obstruction which on steady pressure will yield with that species of quivering that is peculiar to spasm of muscular fibre. Then again, the fact that a patient would at one time pass his urine with the most perfect freedom, whilst if it were rendered acrid or acid by drinking spirits, effervescent wines, or other similar beverages, almost complete obstruction would ensue, tends to prove the existence of an occasional spasmodic constriction of the canal. These facts, though sufficiently convincing to many surgeons, had failed to carry proof of the existence of spasmodic stricture to others, until the recent researches of Kölliker and Hancock, which have above been referred to, set the question of the muscularity of the urethra finally at rest.

In spasmodic stricture we find evidence of narrowing of the urethra, and consequent impediment to the free flow of urine, rapidly supervening under the influence of certain causes, and as speedily subsiding. A patient, for instance, in his ordinary health, and passing water freely, may, if he take such food or

drink as will give rise to a very acid condition of his urine, if he be exposed to cold, or get out of health in any way, suddenly find himself able only to pass his water in a small stream by drops with much straining, or may even be seized with complete retention. Under appropriate treatment these symptoms rapidly subside, recurring, however, on the application of any exciting cause. At the time of the occurrence of this spasm there is often a sensation of weight and uneasiness in the perineum, with evident irritation of the urethral mucous membrane, as shown by reddening of the lips of the orifice: in fact, a tendency to a combination of the congestive with the spasmodic form of stricture. The causes of spasmodic stricture are usually such conditions as occasion a relaxed and irritable state of system, as long residence in hot climates, more especially if conjoined with habitual excesses in drinking, high living, and venereal indulgences. The more immediate causes are usually any circumstances that occasion irritation of the urethral mucous membrane, which, being propagated to the organic muscular fibres beneath, calls them into activity and thus gives rise to the spasmodic affection. The most usual of these are those conditions of the system in which the lithates are largely eliminated, as exposure to cold and wet, by which the action of the skin is suspended, too free an indulgence in spirituous and acid liquors, — such as red or effervescent wines, beer, or punch, — which are well known to give rise to an attack in many constitutions.

Treatment of spasmodic stricture. — If the patient is suffering from spasmodic difficulty in making water, a suppository, consisting of ʒj of laudanum in a little starch, should be thrown up the rectum, the warm hip-bath used, and a full dose of Dover's powder administered. As the opium begins to take effect, the urine will usually be passed without much difficulty. The bowels should then be made to act, when the patient will usually be relieved. If the spasm continue, as it often does, for some days or weeks after this, a full-sized wax bougie should be introduced every second or third day, in order to lessen the irritability of the urethra. In some cases this is more effectually done by the use of a plated bougie, well warmed and oiled. Whatever instrument is used should be of large size, from No. 8 to 10. A small bougie will often be arrested and will create much irritation when a large one will pass readily. If the use of the instrument causes irritation and increase of spasm, it is better to omit it entirely, and to trust to constitutional treatment. But the surgeon must not be discouraged if the first few introductions of the bougie appear to increase the irritation; as the urethra becomes accustomed to the use of the instrument, relaxation of the spasm will take place. At the same time the patient's general health should be carefully attended to; the bowels must be kept open, and the diet regulated; all acids, stimulants and sweets, being carefully avoided. During the time that the bougie is being used, he should take, three times a day, a draught, composed of twenty minims of liquor potassæ, with the same quantity of tincture of henbane and sweet spirits of nitre in camphor julep.

As a preventive treatment of these attacks, a careful regulation of the diet, warm clothing, with the use of flannel, and keeping the skin in action by means of horsehair gloves and tepid baths, will be found serviceable.

2d. *Congestive stricture.* — Many surgeons look upon *spasmodic strictures* as essentially dependent on congestion of the mucous membrane of the urethra, overlooking altogether the existence of spasm, or considering it as the result of irritation of the perineal muscles, and not of the true organic muscles of the canal. That the two conditions of congestion and spasm are frequently associated in the urethra, in the relation of cause and effect, there can be no doubt; and this is the most frequent condition in which spasmodic strictures are found. Indeed, congestion plays an important part in all forms of stricture; it may, as we have just seen, be connected with the spasmodic variety, it may occur alone, or it may be associated with organic stricture. Some parts of the urethra appear to be more subject to congestion than others; thus, for instance, the membra-

nous and prostatic portions, especially the folds of mucous membrane constituting the verumontanum, are peculiarly liable to become congested.

Congestive strictures frequently occur as the result of chronic and long-continued inflammation of the urethra, or of the passage of urine that has been rendered irritating by being too concentrated, or by an admixture of an undue proportion of lithates. It is especially in gouty or rheumatic subjects who suffer from irritability of the skin and mucous membranes that this condition occurs. In these cases there is no true or permanent obstruction, but the disease is transitory, and solely due to a swollen state of the membrane of the part.

In congestive stricture we not only find the common symptoms occasioned by an impediment to the free passage of the urine; but some swelling of the lips of the urethra with reddening and eversion of them. There is also slight gleety exudation, and not unfrequently an abundant puriform discharge, in fact urethritis of a marked kind, with a sense of weight or fulness in the perineum, pain in micturition, and sometimes uneasiness in defecation. This state of things constitutes a very troublesome affection, intimately connected with the various forms of urethritis, and exceedingly apt to relapse from apparently very trivial circumstances, slight errors of diet, dyspeptic derangements, or any local sources of irritation.

The *treatment* in these cases should consist in careful regulation of the diet and habits of life, and especially in the administration of the alkaline and sedative mixture above indicated in combination with small doses of copaiba. In many cases a course of Plummer's pill, in conjunction with the compound decoction of aloes, will be found of essential service. If there is much tenderness or weight about the perineum, the application of leeches to this part, together with the use of the warm hip-bath, will be serviceable.

Congestive strictures, though more influenced by constitutional than local means in many cases, yet require the introduction of bougies in order to prevent the constriction becoming permanent. In some instances a wax, in other a silver or pewter instrument, will be found to answer best. Whatever is used, care should be taken to introduce it slowly and with every possible gentleness. With all care some hemorrhage usually follows the passage of the instrument, not from laceration, but simply as the result of compression of the mucous membrane, and the discharge of which appears rather to be beneficial than otherwise.

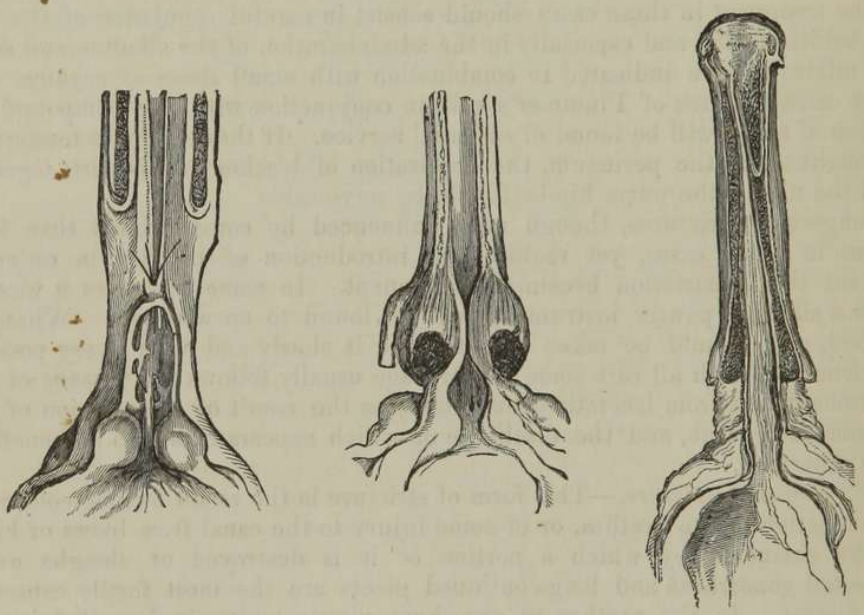
3d. *Organic stricture.*—This form of stricture is the result of long-continued inflammation of the urethra, or of some injury to the canal from blows or kicks in the perineum by which a portion of it is destroyed or sloughs away. Repeated gonorrheas and long-continued gleets are the most fertile causes of this disease. In the urethra as elsewhere, plastic matter is deposited in and around the mucous membrane, as the result of inflammation; consolidation of this takes place, followed by contraction of the canal. The long continuance of inflammation is more to be dreaded than its intensity in occasioning this mischief; hence it is of great importance, not to allow gleets to run on indefinitely, as they will almost to a certainty be followed by constriction of some portion of the urethra.

The *seat* of organic stricture varies considerably, indeed any portion of the urethra may be affected by it, except the prostatic. It appears to be the common belief amongst surgeons, that the membranous portion of the canal is the most frequently affected by this disease. This, however, there can be little doubt, is an erroneous opinion. Mr. Henry Smith has examined 98 specimens of stricture contained in the different London museums; of these he found only 21 seated in the membranous portion of the urethra, whilst 77 were anterior to the triangular ligament; the majority of these being either in the bulbous portion of the urethra, or a little in advance of this. Mr. Henry Thompson,

in his excellent work on Stricture, states as the result of his numerous observations, that stricture is more frequently met with at the junction of the spongy and membranous portions of the urethra, next, about one inch anterior to this, and most rarely, so far back as the membranous portion itself; lastly, he states, "I can confidently assert that there is not a single case of stricture in the prostatic portion of the urethra to be found in any one of the public museums of London, Edinburgh, or Paris." Not unfrequently strictures are met with at the mouth of the urethra, and occasionally they are multiple, two very frequently occurring, and sometimes as many as four or five. When there are several strictures, one will always be found at the bulb or in the membranous portion of the urethra.

The characters of organic stricture vary greatly; in some cases it is annular, encircling the whole of the canal, and occasionally for some little distance. These elongated annular strictures usually arise from consolidation of the corpus spongiosum by plastic matter compressing the urethra, as in fig. 343. In other cases again, annular strictures may be narrow and sharp-edged, and are then called pack-thread or bridle strictures; consisting of bands stretching across the urethra (fig. 342). Sometimes there are several of these in close proximity

Fig. 342. Fig. 343. Fig. 344.



to one another, leaving merely narrow passages between or under them. These bands occasionally stretch directly across the canal, but at other times and more commonly they take a somewhat oblique direction (fig. 344). It is not very clear how these bridles or frena stretching across the urethra are formed. It can scarcely be by the effusion of plastic matter; it is more probable that they are occasioned by a valvular projection of the mucous membrane which has been perforated, perhaps by the point of the catheter, and thus apertures produced in it. These various kinds of organic stricture are hard and elastic, sometimes, when old, almost cartilaginous in their density, feeling gristly and rough to the instrument that passes over them.

The amount of constriction varies greatly in organic stricture, from merely slight narrowing of the channel to almost complete obstruction of it. A question has arisen whether the canal of the urethra is ever rendered completely impermeable by a stricture. In answering this, it is necessary to be agreed upon the meaning of the term "impermeable." If by it is meant impenetrable to the

passage of a catheter, there can be no doubt that such strictures may occasionally, though very rarely, occur, the channel being so narrow, oblique, or tortuous, that the instrument cannot be passed through it. Strictures, however, of this description, may usually be ultimately made permeable to instruments by proper and careful treatment. If by "impermeable" is meant generally impervious to the passage of urine, there can be no doubt that such a condition does not exist. It would clearly be incompatible with life, unless a fistulous opening existed behind the stricture, through which the urine might pass out; and, even with such an aperture existing, I have never heard of, or seen a case in which no urine whatever escaped by the meatus, unless in consequence of injury or disease a portion of the whole calibre of the urethra had sloughed away; and it is clear that so long as any passes out in this way, a stricture cannot be looked upon as truly impermeable.

When an organic stricture is once formed, it will continue unless removed by surgical means, and as it usually becomes more closely contracted, it will offer an increasing obstacle to the free flow of the urine, and thus eventually tend to give rise to important structural changes in the urinary apparatus.

The urethra behind it becomes increased in diameter, sometimes dilated into a true pouch, in which sabulous masses, and even small calculous concretions occasionally collect. The bladder, subjected to increased pressure by the necessity of overcoming the obstacle to the passage of the urine, becomes thickened and fasciculated, the ureters are often found dilated, from a tendency to a reflux of the urine, or to compression of their vesical orifices, in consequence of the altered structure of the bladder. The kidneys become irritated, congested, and at last the seat of some of those various structural changes that, by impairing their functions, and interfering with the proper depuration of the blood, may eventually destroy the patient.

Symptoms of organic stricture. — It is surprising how much constitutional irritation is set up in some systems by a stricture, even though it be not very tight. The interference with the free flow of the urine causes irritation of the bladder and kidneys, the secretion from which becomes less abundant than usual; in consequence of this, the actions of the skin, and other depurative organs, are deranged, and thus the system at large is influenced and suffers.

The local signs of stricture are always well marked, and are very unequivocal. The disease usually commences with the retention of a few drops of urine after evacuation of the contents of the bladder. The patient finds that he has to make water more frequently than usual, particularly at night; there is some straining, perhaps a slight gleety discharge, and a feeling of weakness about the genital organs. The stream of urine has changes impressed upon it during its passage through the stricture, by which its shape and direction are modified; thus, it may become forked, scattered, twisted, fan-like, or be discharged in a double current — one projecting directly forwards, the other dropping perpendicularly downwards. As the disease advances, these symptoms necessarily become more marked, until they may terminate in complete retention; they, however, often come on in a very insidious manner, and when the patient seeks advice he is found to be already the subject of a very tight and intractable stricture; indeed, in some cases, the first circumstance that directs the attention of the patient to his complaint is the sudden occurrence of retention of urine.

The existence of stricture can, however, only be determined with certainty by the introduction of an instrument down the urethra. In exploring the canal in a suspected case, two points have to be ascertained—the existence of a stricture, and its degree of tightness. The existence of a stricture is best determined by passing a plated steel sound, or a silver catheter of medium size, about No. 8, well oiled and warmed. This will readily pass so far as the constricted point, but then be arrested. In this exploration, too small an instrument must not be used, lest it hitch in the fossæ of the urethra or against the verumontanum, and

this accidental arrest be mistaken for the obstruction produced by the stricture; or it might pass through the stricture, and thus mislead the surgeon. The existence of a stricture having been ascertained, the next point is to determine its degree of tightness. This is best done by withdrawing the instrument previously used, and then introducing a smaller one about the size of the stream of water that the patient makes. If this fail to enter the stricture, a smaller one still must be used, until that size is reached, which can be introduced with but a moderate degree of force. In this way the existence, the seat and degree of tightness of the stricture, are ascertained. The tact of an experienced surgeon will also lead him to judge to a certain extent of the length, degree of induration, &c., of the constriction.

The employment of soft wax bougies has been recommended with the view of taking a mould of the size, shape, and direction of the stricture, by pressing the end of the instrument into it; but no possible advantage can be derived from this proceeding, and a surgeon accustomed to the use of metallic instruments can obtain all this information with more certainty by the finer touch afforded by them.

The *treatment* of strictures of the urethra may be conducted by three methods — 1st, *mechanical dilatation;* 2d, by *caustics;* and 3d, by the *division* of the contraction. Whatever plan of treatment be adopted, the surgeon must bear in mind that his operations have to be conducted upon a tender canal endowed with exquisite sensibility, that sympathizes closely with the conditions of the general system, and in which improper violence or too active measures may set up a degree of irritation that readily extends to neighboring structures, and thus jeopardizes the life of the patient. But though it is necessary to recollect all this, he must not run into the opposite and equally dangerous extreme of adopting inefficient measures for the removal of the obstruction. A bad stricture is one of the most serious diseases that the human frame is liable to, and will almost inevitably, if left to itself, terminate fatally by the induction of renal disease; and we must therefore not hesitate to adopt sufficiently energetic measures for its removal; and if these are properly conducted, there is scarcely any affection in which the surgeon can afford his patient greater relief than in this. At the same time, however, that local means are being used, constitutional treatment should not be neglected. Organic stricture is often more or less associated with spasmodic or congestive stricture, and requires the same constitutional treatment, modified according to circumstances that are necessary in these affections — proper regulation of diet, avoidance of all articles of food that generate lithates, care not to allow the urine to become too concentrated, and attention to the maintenance of the healthy action of the liver and skin, will tend much to increase the patient's comfort, and to ward off the more serious consequences of stricture.

1st. *Mechanical dilatation*, as it is erroneously termed, is the usual and certainly the most successful mode of treating ordinary strictures; but it is not the mere stretching, or forcible dilatation of the stricture, cures it. The means employed to produce dilatation tend to promote the absorption of those plastic matters effused in and underneath the mucous membrane, which especially constitute the stricture, and thus to occasion a permanent cure.

The instruments that are used for dilatation are either metallic, such as silver catheters, steel sounds, plated or pewter bougies; or made of some soft and yielding material, as gum-elastic catheters, catgut, wax, or elastic bougies. Though most surgeons will prefer one kind of instrument to another, it is well not to be too exclusive in the use of any one; for it will be found in particular strictures and certain constitutions advantageous to depart from the ordinary practice, and that the surgeon may modify with great benefit to his patient the mechanical means that he adopts. As a general rule, I think that metallic instruments are decidedly preferable, more especially when the stricture is tight,

cartilaginous, and of old standing; nothing will pass such a stricture as this so readily as a well-made steel sound or silver catheter.

The shape and curve of catheters and sounds is of much importance; the best curve for these instruments, I think, consists of the one-fourth of the circumference of a circle 4½ inches in diameter. If sounds are used, they should be made slightly conical, so that the thickest part corresponds to the bend of the instrument, and be well rounded at the point. Sounds are particularly useful when the stricture will admit a moderate-sized instrument. The sound should have a broad metallic handle, which transmits any sensation communicated to the point more accurately than a wooden one. If a catheter be used,—and this instrument is most applicable in small strictures, in which, if the difficulty of introduction be great, it may advantageously be left, — it should be made very solid and stiff. The rings should be large, so as to serve for a handle, and the eyes well rounded off and somewhat depressed, so that they may not scrape the urethra. These instruments should be used with every possible care and gentleness; but though no one more strongly recognizes than I do the necessity of not employing unnecessary violence in their introduction, yet it is useless to think of getting through a tight hard stricture without the employment of some degree of force. The catheter or sound will not "find its own way" here, as it may in a healthy urethra; but it must be guided and directed by the hand of the surgeon, and there is scarcely an operation in surgery that requires more tact and delicacy of manipulation than that of passing an instrument through a tight, or, as it is termed, an impermeable stricture. Here some degree of force must be used, but the skill is shown in proportioning this to the amount of resistance, and in using it in a proper direction. The appearance of force is indeed often greater than in reality; for though the point of the catheter have got through a tight stricture, it may still require considerable pressure to push the rest of the instrument through it.

Catheters and metallic sounds are best introduced by laying the patient flat upon his back, with the pelvis somewhat raised, and the head and shoulders low. The surgeon, standing on his left side, inserts the instrument well warmed and oiled into the urethra, with its concavity turned towards the left groin, and passes it down the canal, at the same time drawing the penis upwards with his left hand, so as to put the mucous membrane on the stretch. As the instrument approaches the triangular ligament, the handle is carried to the mesial line, and at the same time raised perpendicularly; and, as its point passes under the pubes, it should be kept well against the upper surface of the urethra, and made to enter the bladder by depressing the handle towards and between the thighs. The surest guide to the bladder is the upper surface of the urethra, which is more fixed than the lower, and less liable to the existence of fistulous openings or false passages. Should difficulty be experienced, the introduction may be facilitated by injecting and slightly distending the urethra with oil before passing the instrument.

If the stricture be not only very tight, but twisted, it may be somewhat difficult to get a metallic instrument through; and then the plan recommended by Sir B. Brodie may be advantageously employed. This consists in taking a fine catgut bougie, and bending it in this shape, about an inch from the point, so as to follow the track of the stricture more closely. In this way strictures that are otherwise impassable may be got through with comparative ease. Under the influence of chloroform, however, many strictures may be readily passed with metallic inrtruments that are not pervious in any other way. I have repeatedly succeeded by its use in passing catheters through very tight strictures which had been impenetrable for months or years without this agent.

Gum-elastic bougies and catheters and wax bougies are not nearly so manageable as metallic instruments, usually bending back against tight strictures;

in fact, it is only in those of a spasmodic and congestive kind, in which a large instrument will readily pass, that they are of much service. They are usually best introduced whilst the patient is standing, and they generally glide most readily into the bladder if they have been slightly curved before being passed. When they are of wax, it is useful to smooth them down between the fingers before introducing them. In using the elastic catheter, a stylet is usually required; but in some cases the instrument appears to enter more easily without this. In others again, it may be passed with the stylet down to the stricture, and then partially withdrawing it, the point of the catheter will start up, and thus more readily slip in.

The introduction of an instrument usually gives rise to a smarting, painful sensation in the urethra, which is generally most severe as its point approaches the neck of the bladder, and is then sometimes attended by nausea and sudden faintness. As a general rule the instrument should be passed every second or third day, and when introduced should be left in for about five minutes, or until the spasm about the urethra induced by its introduction has subsided. If, however, the stricture is extremely tight, a very small catheter only having been got in, the instrument may be left for twenty-four or forty-eight hours, when it will be found that however tightly grasped it originally had been, it has become loosened; a slight discharge being at the same time set up from the urethra. It may then be readily withdrawn, and when the irritation has subsided at the end of a couple of days, a considerably larger one introduced.

The augmentation of the size of the instrument should be very gradual. It is fully sufficient to increase it by one number at each time of introduction. Many urethræ even will not bear this, and it becomes necessary to pass the same instrument on two or three successive occasions before a larger size can be introduced. The size of the instrument may be gradually increased until that is reached which the urethral orifice readily admits; beyond this, the surgeon should not go; but so soon as the full size, usually No. 12 or 14, can be introduced with ease it should not be passed so frequently as before; once a week or ten days, and gradually with less frequency. But for some length of time to come it will be necessary to introduce it at least once a month or six weeks, lest contraction take place again.

If the size of the instrument be increased too rapidly, irritation may be set up, and inflammation of the testicles, and abscess in the perineum or prostate induced. I have more than once had occasion to regret being in too much haste to increase the size of the instrument, and by augmenting it by two or three numbers at one sitting, have seen the patient thrown back for weeks by the supervention of some of the affections just mentioned.

When the stricture is situated solely at the urethral orifice, the best instruments for dilatation are nail-headed styles of graduated sizes. These strictures are, however, very troublesome, and have a great tendency to relapse.

An ingenious and in some instances a valuable method of dilating strictures has been brought before the profession by Mr. T. Wakley. It consists in passing a small-sized silver stylet through the stricture, and then slipping over this, a catheter, which is to be gradually increased in size until the urethra is fully dilated.

By dilatation, properly carried out, most strictures may be considerably relieved in the course of a few weeks; and the majority cured by continuing the treatment for a sufficient length of time. Some, however, cannot be dilated in this way; it would appear that the tissue of which they are composed is so contractile that although they may be expanded up to a certain size — say up to No. 5 or 6 — it is impossible to get beyond this. In other cases again there is a great tendency to relapse, and for the constriction to return; the stricture rapidly becoming tighter so soon as the introduction of instruments is discon-

tinued: in these cases other measures that will be described must be had recourse to.

The introduction of instruments occasionally gives rise to certain troublesome sequences. Amongst these, syncope and rigors, hemorrhage, inflammatory irritation about the urethra or testes are the most common. In certain constitutions, usually of a nervous and irritable character, there is a great tendency to the occurrence of shivering and faintness after the passage of an instrument, more particularly as it approaches the neck of the bladder. These effects usually go off after the withdrawal of the catheter, but in some cases they may continue for many hours, or even come on after the lapse of some time; the rigors under these circumstances being very distinct and intermitting, so much so as to resemble an ague fit. In such cases as these a full dose of Dover's powder or of laudanum in some warm brandy and water will usually give the patient most relief. This accident is seldom attended with any danger, though in one case I have known death follow the introduction of a catheter apparently from syncope and nervous causes.

Hemorrhage, which is sometimes rather profuse, may follow the introduction of a catheter, especially if the stricture is congestive and the instrument employed small. It generally ceases of itself, but if it be troublesome the application of cold will check it.

The inflammation about the urethra and in the testes that occasionally occurs during the treatment of stricture is best guarded against by not using too large catheters, and by directing the patient to abstain from much exercise during the time of their introduction.

False passages are occasioned by the instrument passing out of the urethra through its coats into the surrounding tissues. They are especially apt to occur in tight bridle strictures, when a small instrument is being used, and more especially if the direction of the constriction is somewhat oblique, so that the point of the sound is thrown against the side of the canal (fig. 335). The extent and situation of a false passage necessarily vary according to the position of the stricture; and the danger is usually in proportion to its depth. The false passage usually takes a direction downwards and to one side of the urethra. If the stricture be far forwards, it may run into the corpus spongiosum, but if in the usual situation, it may perforate the lateral lobe of the prostate, or run between this and the rectum, being unable to extend upwards on account of the rigid nature of the structures in this situation. When the false passage merely perforates the corpus spongiosum, running parallel to the urethra, and opening again into the canal, or when perforating a portion of the prostate it enters the bladder, it is not necessarily attended with much danger; but when it enters the cellular tissue between the bladder and the rectum, breaking up this structure to a great extent, admitting urine into the recto-vesical space, and about the neck of the bladder, then the most serious consequences, such as inflammation and abscess in this neighborhood, are apt to ensue, which may not unlikely be followed by the death of the patient.

At the moment that a false passage is made, during the introduction of an instrument, by the surgeon using too much force or pressing in the wrong direction, he feels the point make a sudden slip, which the direction of the shaft indicates to be to one side of the urethra. The patient complains of severe pain, and is often conscious of a laceration; there is a grating or rough sensation communicated by the tissues amongst which the instrument has passed, and though it has entered deeply, it will be found not to have reached the bladder. On the surgeon introducing his finger into the rectum, he probably feels the point of the instrument in the cellular tissue between the gut and the bladder; on withdrawing it, it will be found covered with blood, and there will be free hemorrhage from the urethra.

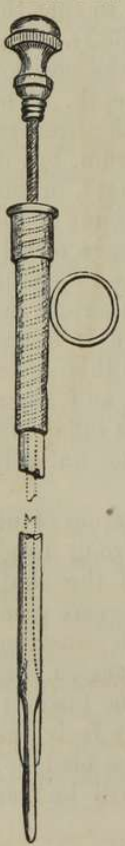
The surgeon knows when he has entered an old false passage by the change that takes place in the direction of the instrument, by its not reaching the

bladder, and by the rough sensation communicated to it, very different from that afforded by the smooth lining of the urethra. The patient is often conscious of the existence and of the entry of the instrument into the false passage, and will warn the surgeon of it. If the surgeon is aware that he has made a false passage, he, if possible, should at the time of the accident pass a larger catheter into the bladder, and leave it there for a few days until the laceration has healed. If there be an old false passage, he must be careful, by keeping the point of the instrument away from it, not to enter it, lest during the introduction of the catheter he raises with the point of the instrument the valvular angle that intervenes between it and the urethra; every time that this is opened up it tends to lessen the chance of a closure of the aperture, whilst overlapping the urethra it interferes with the onward passage of the instrument into the bladder. By withdrawing the instrument, and changing its direction, the false passage may often be avoided, and the bladder reached. Should there have been much difficulty in getting it in, the better plan will be to retain it for two or three days, when the canal may possibly close.

It has already been stated that in certain forms of stricture, dilatation does not succeed in effecting a permanent cure. In these cases two plans of treatment have been recommended, the destruction of the stricture by caustic, and its division by the knife.

2d. In the *treatment of stricture by caustics* two objects are endeavored to be attained; the first is the destruction of the stricture; the second, the diminution of the sensibility of the surrounding mucous membrane, so that the irritability and spasm of the canal may be lessened. The following is the way in which the caustic is applied. A wax bougie, well-oiled, is passed down to, but not through the stricture; the surgeon then with the thumb-nail, makes a notch on that portion of the instrument opposite to the meatus. Another bougie of similar length and size is then taken, and armed by a piece of potassa fusa, about the size of a small pin's head, being placed in a depression at its end. A mark is now made on it, at a point corresponding to the notch on the first bougie, it is then passed rapidly down until this mark comes opposite to the meatus, and then pressed firmly for two or three minutes against the stricture, upon which the caustic exercises its action. This application, which is followed by a gleety discharge, is to be repeated every second or third day, until a proper sized bougie can be introduced; and then the dilatation may be proceeded with in the usual way. This practice, stigmatized by Mr. Liston as "most atrocious," has now but few advocates, and indeed there appears to be nothing that it effects but what can be accomplished much more safely and easily by a catheter or sound in an ordinarily skilful hand.

Fig. 345.



The *division of the stricture* may be practised either from within the urethra or from without, through the perineum. The division *from within* may be performed in two ways, 1st. By passing a concealed steel stylet down to the stricture, and then pushing forwards the lancet-like knife, attempting to perforate the obstruction. This plan is only applicable with safety to those strictures that are situated in that part of the urethra anterior to the scrotum, where the canal is straight. In the deeper and more curved parts, any attempt at perforation would be fraught with danger; for as it would of course be impossible for the surgeon to guide the stylet exactly in the direction of the urethra, it would be as likely to perforate the walls of this canal as to pass through the stricture. In hard and resisting contractions, however, in the straight portion of the canal anterior to the scrotum, this instrument may occasionally be used with advantage. The most convenient form of cutting

stylet is the one figured here, which has a probe end, that is introduced through the stricture, and serves as a guide to the blade, which is projected and caused to retract into its cylinder by the action of a spring (fig. 345).

Another mode of dividing strictures from within the urethra, is to pass a catheter containing a stylet through the stricture, and then projecting the stylet as the instrument is withdrawn, notching the obstruction. As the stricture however must be of considerable size to admit of such an instrument as this; it is usually sufficiently amenable to other modes of treatment, and will therefore render such a procedure necessary. The internal division of the stricture has always been a favorite method of treatment in France, and of late years not a few complicated and dangerous machines have been invented, by which a process of cutting or lacerating the division of the stricture is sought to be effected. Such contrivances are only mentioned in order to be condemned as in the last degree dangerous and improper.

The division of the stricture *from without* by incision through the perineum, may be performed by two distinct operations: the one being only applicable to those strictures that are pervious to an instrument; the other to those which are impermeable. In the first case, a grooved staff is passed through the stricture and the section made upon this. In the second case the surgeon attempts to cut into and through the stricture, without any guidance except such as his anatomical knowledge may afford him.

OPERATION FOR PERMEABLE STRICTURE.

The first of these operations introduced by Mr. Syme as *urethrotomy*, and commonly called the "*perineal section*," is a comparatively simple procedure. The instruments required for its performance are a staff, a No. 8 silver catheter, a pointed scalpel, and a broad director. The staff should vary in size from No. 1 to No. 6, according to the tightness of the stricture; it should be grooved along its convexity, either the whole of the way, or better, merely for the lower third (fig. 346). The stem being smooth and of full size, and joining into the lower grooved part by a distinct shoulder, which being passed down as far as the stricture forms by its projection a guide to that part of the urethra requiring division. In those cases in which there are false passages a hollow staff may be advantageously used of the same size and shape; the flow of urine through it indicating with certainty its passage into the posterior part of the urethra.

Fig. 346.

The operation is performed as follows: — The staff having been passed well through the stricture so that the shoulder rests against the upper part of the constriction, the patient is tied up as for lithotomy, and the surgeon seating himself in front, pushes the scalpel, with the back of the blade downwards, into the mesial line of the perineum a little above the rectum, and cuts upwards for an inch or more in the raphe. The dissection is carried on very carefully exactly in the median line until the staff is reached, when the knife must be entered into its groove *behind* the stricture, and carried forwards through this. The staff having then been pushed on to ascertain that all is free must be withdrawn, and a No. 8 catheter introduced which is to be kept in for forty-eight hours; it must then be taken out, and at the end of eight or ten days the urethra dilated by the introduction every second day of a full-sized silver catheter. Urine escapes for some little time by the perineal incision, but as this heals by granulation, the flow of fluid gradually lessens and at last ceases entirely.

The principal points to be attended to in this operation are —

1st. To see that the staff is fairly through the stricture, and to be especially careful in determining this if false passages exist.

2d. To cut carefully in the median line, where, as Mr. Syme has observed, a kind of septum exists even in the deeper structures of the perineum, and where there can be no danger whatever of dividing any artery of magnitude, which might happen if any lateral deviation of the knife took place. The only vessel indeed which is at all endangered is the artery of the bulb, and this may always be avoided by carefully keeping in the raphe, as it lies towards the side of the incision.

3d. To enter the point of the knife behind the stricture, and to divide that by cutting forwards in the groove of the staff.

4th. Not to turn the edge of the knife downwards; if this be done the deep perineal fascia may be opened and danger of pelvic infiltration and inflammation incurred.

5th. Much difficulty has occasionally arisen in the introduction of the catheter into the bladder after the division of the stricture. This may always be avoided by adopting the suggestion of Mr. Henry Thompson, of passing a broad director, with the groove turned up, into the posterior part of the urethra after the stricture has been cut, but before the staff is withdrawn. As the catheter is passed down the canal its point will infallibly be guided by this onwards into the bladder.

When there are more strictures than one, the division of the deepest is usually alone necessary.

Although fatal cases of perineal section have occasionally been recorded, yet this is nothing more than we must expect to happen from time to time in any operation that is performed on the urinary organs whilst diseased, more particularly if there be a granular condition of the kidneys, a state of things in which I have known the simple introduction of the catheter followed by death in six or seven hours. If I understand Mr. Syme right, it is with the view of preventing the ulterior inevitable fatal consequences of all intractable strictures that he has proposed this plan of relieving the obstruction, by dividing it from without, in those cases in which ordinary methods notoriously fail, and in which there is no alternative but to perform urethrotomy, or to leave the patient to his fate. In order that this operation should be successful we must not wait for the occurrence of those changes that are the result of the chronic obstruction, such as disease of the bladder and kidneys, and which must inevitably increase the danger of any operation; but we must divide the stricture with a view of preventing them.

The most important question in connection with this operation, is in what class of cases it should be practised. That most strictures may be cured by dilatation, there can be no doubt; most practitioners holding with Liston, that whenever a catheter can be got through a stricture, its cure by dilatation is in the surgeon's hands. Though this may be generally true, instances not unfrequently occur, however, in which dilatation fails to effect a cure; the stricture, as I have already remarked, being highly contractile, and not admitting of expansion beyond a certain point, relapsing whenever the dilating means are removed. In other cases also the patient suffers so much pain and irritation whenever an instrument is passed, that he cannot bear the repeated introductions which are necessary if the stricture be complicated with fistulæ in perineo or false passages, and which render its cure by dilatation tedious and almost impracticable. In such cases as these the surgeon, being unable to benefit his patient materially by dilatation, must choose between the employment of urethrotomy and palliative means.

There are four classes of cases in which urethrotomy may be advantageously employed.

1st. In very old dense cartilaginous strictures, often of traumatic origin, which admit an instrument with great difficulty, and cannot be dilated beyond a certain point, owing to the conversion of the urethral structures into a kind of dense,

fibrous, almost cicatricial tissue, that neither admits of expansion nor of absorption by the pressure of instruments; and in which a considerable extent, half an inch or more, of the urethra is involved.

2d. The same kind of stricture complicated with fistulæ in the perineum or scrotum, with perhaps considerable plastic infiltration of these parts.

3d. Very tight strictures accompanied by excessive sensibility of the urethra; in which each introduction of the instrument is attended by intense suffering, spasmodic movements of the limbs and rigors, so that the patient cannot be induced to submit to a proper course of bougies.

4th. Very elastic, though perhaps narrow strictures, that can be dilated readily enough, even up to the admission of full-sized instruments; but which when the treatment is discontinued immediately begin to contract again, so that the patient is never out of the surgeon's hands and sees no prospect of cure.

The whole value of the "perineal section" will at last depend on the liability of the stricture to return after its division, and this point has not as yet been by any means satisfactorily determined. The ultimate result of the cases in which it has been practised has not as yet been fully laid before the profession, and until this has been done we cannot consider the utility of the operation as established, except as a means of temporary relief in cases of the kind just mentioned. Much will certainly depend upon keeping up dilatation of the urethra for some months after the division of the stricture, a catheter of full size being passed once in a week or ten days. If this precaution be neglected, relapses will often occur; and even when scrupulously attended to they are, I believe, by no means unfrequent.

In order to perform the perineal section it is necessary that the stricture should be pervious to a grooved staff, however small this may be; and this it might be supposed would limit materially the cases in which the operation can be performed. But complete obliteration of the urethra cannot take place except as the result of sloughing, usually consequent on injury; indeed "impermeable" strictures, though frequently spoken of, are very rarely met with. Mr. Syme, indeed, denies their existence, and states that if urine can escape through a stricture, a bougie can be got in. A surgeon may often be foiled in his first attempts in getting an instrument through a very tight stricture, but I believe that with patience, by attention to constitutional treatment, so as to lessen urethral irritation, and especially by the administration of chloroform, he will usually at last succeed in getting an instrument of some kind through the very worst strictures. In the first case in which I performed the perineal section, almost all the urine had for twelve years been discharged through fistulous openings in the perineum and scrotum; and the principal portion escaped through a large hole on the inside of the left thigh, a few drops merely occasionally passing out by the lips of the urethra. No instrument had been passed for four years, though repeated attempts had been made by different surgeons. Being foiled in getting a catheter into the bladder the first time I tried, I kept the patient in the hospital for two or three weeks, attending carefully to his constitutional condition, but without making any further effort. He was then placed under chloroform, when I succeeded in passing No. 1. The urethra was then dilated up to No. 5, beyond which no instrument could be passed, when the perineal section was performed. The patient made an excellent cure, the fistulous openings closing, and the urine being discharged by the natural channel. In another case which I attended with Mr. Bryant, persevering attempts had been made for five years to get an instrument into the bladder, but without success, the stricture not only being excessively tight, but the urethra acutely sensitive; under chloroform I succeeded in getting No. ½ silver catheter into the bladder, and speedily cured the patient. In a case of extravasation of urine following stricture, consequent on injury of the perineum, sent to me by Mr. Corrie of Finchley, in which no catheter had been introduced for eight years, it

was found after death that although the urethra had been converted into a mass of cicatricial tissue at the part injured, yet that it was permeated by a narrow tortuous passage, through which the urine had escaped.

The influence of anæsthetics in facilitating the passage of instruments through apparently impermeable strictures, is very marked. Shortly after the introduction of ether as an anæsthetic agent, Mr. Liston was going to cut through a stricture that had resisted all attempts made by his most dexterous hand at getting an instrument into the bladder; but no sooner was the patient put on the table and fairly rendered insensible, than the No. 8 silver catheter, which had been passed down as far as the stricture, and the point of which was to serve as a guide to the knife, slipped into the bladder, and thus rendered a dangerous operation unnecessary.

But yet no surgeon can doubt that cases do occasionally though rarely occur, in which, in consequence of extravasation of urine and old inflammatory action, the urethra has become so tortuous and narrow, and the perineum so indurated and disorganized, that an instrument cannot be got through, even though urine pass out readily. It must be borne in mind that a stricture may be permeable to urine, but impermeable to a catheter, even in the most dexterous hands. It does not follow necessarily, that because a fluid will trickle out of a narrow and tortuous channel, that a catheter or solid sound can be passed into it from without. Hence cases will occasionally occur in which the perineal section is not practicable.

In the event, therefore, of a stricture being so tight and tortuous that no instrument can be got through it, or where a portion of the urethra having sloughed away, its canal is obliterated, neither the cure by dilatation nor urethrotomy can be performed, and it may then be necessary to have recourse to incision of the stricture without a guide.

OPERATION FOR IMPERMEABLE STRICTURE.

This operation is performed as follows: A No. 8 silver catheter is passed down to the stricture, the patient is then tied up as if for lithotomy, and the surgeon sitting in front, pushes a bistoury, with the back turned towards the rectum, into the raphe of the perineum as far as the apex of the prostate, so as, if possible, to open the dilated urethra *behind* the stricture. He then cuts forwards through the stricture on to the point of the catheter, and thus having opened a passage, endeavors to pass that instrument on into the bladder. It is often extremely difficult to find the posterior part of the urethra; but in some cases this part of the operation may be facilitated by passing a grooved director or straight female catheter into it to act as a guide. When the tissues of the perineum are hard and gristly, altered by the effusion of plastic matter, and condensed by repeated attacks of inflammation and the existence of fistulæ, it is a most difficult matter to dissect through such an altered mass and hit the urethra beyond it; and the difficulty is still further increased by the bleeding, which is often profuse. This operation, I have no hesitation in saying, is perhaps the most troublesome in surgery. I have more than once seen the most skilful operators foiled in their endeavors to accomplish it, and compelled to relinquish the operation without concluding it, or only succeed after prolonged and most painful attempts. Fortunately this operation is now scarcely ever necessary; with patience, and under chloroform, the surgeon may almost invariably get a staff, however small, into the bladder; he then has a sure guide upon which to cut, by following which he must certainly be led through the stricture into the urethra beyond it. In all cases, therefore, urethrotomy should, if practicable, be substituted for the division of the stricture without a guide.

COMPLICATIONS OF STRICTURE.

1st. *Retention of urine* has a tendency to occur in all tight strictures, by the gradual and progressive contraction of the canal. It most usually, however, takes place in consequence of a congestive or spasmodic condition being superadded to the organic constriction. It commonly happens that a patient having a moderately tight organic stricture commits an excess, or becomes exposed to cold and wet, and thus gets such a congested condition superadded, that the urine will not pass at all, or only in such small quantity by drops, and with so much pain and straining, that the bladder cannot be completely emptied. In these cases, the retention always eventually becomes complete; the bladder speedily fills, rises up above the pubes, with much distress and constitutional disturbance; and, if relief be not afforded, the distended portion of the urethra behind the stricture will ultimately give way, and extravasation of urine ensue. Under these circumstances, it becomes imperatively necessary to empty the patient's bladder as speedily as possible.

The *treatment* to be adopted varies with the severity of the symptoms and irritability of the patient. If the retention have not continued very long, and if the patient be not very irritable, an endeavor might be made at once to give relief by passing a small catheter into the bladder. In this the surgeon may often succeed more readily than might have been expected, the stricture frequently yielding before an instrument, more easily when there is retention than when this condition does not exist. Even if the catheter do not enter the bladder, its point or that of a catgut bougie merely being got well into the stricture, it will generally happen, as Sir B. Brodie has pointed out, that, on the withdrawal of the instrument, the urine will follow in a full stream; but if a sufficiently small catheter be used—in many cases not larger than half of No. 1 is admissible—the instrument may usually be got fairly into the bladder. If the patient be very irritable, it is better, before attempting the introduction of the instrument, to give him an opiate enema, consisting of ʒj of laudanum in about ℥ij of starch, and to put him in a warm hip-bath; the introduction of the catheter may now be attempted, and will very generally succeed. Should it still fail, the effect of the inhalation of chloroform should be tried, when it almost invariably may be made to pass without the employment of any great or dangerous degree of force. There are no cases in surgery in which chloroform is of more value than in these; under its influence it is seldom, indeed, that the catheter will not pass. After the instrument has been got into the bladder it should be left there, being tied in by means of tapes passing from its rings under the patient's thighs, to a bandage that is passed round his waist. Antiphlogistic remedies must then be employed in rather an active manner, a free purge, leeches to the perineum if there be tenderness in this region, and salines with antimony. The catheter will be found to be loosened at the end of forty-eight hours, when it should be withdrawn, and the cure by dilatation proceeded with in the usual way.

If, however, the surgeon is unable to introduce a catheter in the ordinary way through the stricture, relief must be given to the over-distended bladder in some other way, lest it or the urethra burst, and extravasation of urine occur. The bladder may be emptied in three ways: 1st, by forcible catheterism; 2d, by making an opening into the urethra behind the stricture; or, 3d, by puncturing the viscus itself through the rectum.

1st. *Forcible catheterism* is a most unsurgical and dangerous procedure. Nothing can surely be more improper than to take a small, stiff, silver catheter, pass it down to the stricture, and then, by main force, attempt to drive it on into the bladder. In these cases the surgeon usually fails in his attempt at reaching the viscus, pushing the point of the instrument into the tissues around the neck of the bladder or the prostate, and thus inducing great, and

perhaps even fatal, mischief in these regions. If he should, by some fortunate accident, get into the bladder, it is not by any skilful, though forcible, expansion of the stricture, but rather by perforating the urethra, and burrowing through the corpus spongiosum and prostate, "tunnelling," as it has been termed, until he again enter that canal, or in some such way reach the neck of the bladder.

2d. In the kind of retention of urine that we are now discussing, the safest mode of affording relief after the failure of the catheter, is to make an incision into the middle line of the perineum, and to open the urethra behind or through the stricture. In doing this there is often much less difficulty in cases of retention than when the bladder is empty. In consequence of the urethra being distended by the accumulation of urine, and by the straining of the patient, it sometimes attains a considerable magnitude, though, if this be not the case, the operation may prove a very serious and difficult one. The operation, which is essentially the same as that described at p. 890, for impermeable stricture, is performed by passing a catheter down to the stricture; opening the distended sinus of the urethra *beyond* this; cutting upwards through the stricture upon the end of the instrument; and then passing the instrument on into the bladder, or allowing the urine to flow from the aperture thus made in the perineum. In doing this, care must be taken to keep strictly in the direction of the mesial line, so as not to wound vessels of importance. One advantage of this operation is, that the stricture may by it be cured at the same time that the retention is relieved; and as the incisions do not extend into the bladder, but are limited to the urethra, there is less danger to the patient than when that viscus is opened.

Another advantage of the perineal incision in these cases is, that it not unfrequently happens that urinary abscess has begun to form, or the extravasation of a few drops of urine has taken place sooner than the surgeon may have had any idea of; and if so, the incision through the perineum will afford an exit for any extravasated matters, at the same time that it relieves the patient from the distress and danger of the retention. Should any mischief of this kind have taken place, it is not necessary to be so particular about opening the urethra with the knife, for an aperture having already been established in it, the urine will readily flow through the artificial channel thus formed by free incision into the inflamed or suppurating perineum.

3d. The relief of retention from stricture may also be obtained by *puncturing the bladder through the rectum.* After emptying the bowel by means of an enema, the surgeon passes the left index finger well into the gut, feeling for the posterior margin of the prostate; he then carries the trochar and canula, which are long and somewhat curved, upon this as a guide, and when the extremity of the instrument has reached the posterior edge of the prostate, pushes it upwards into the bladder (fig. 340,*b*). In introducing the instrument into the rectum, the surgeon should withdraw the point of the stylet into the canula, so as to avoid wounding the gut, and not push it forwards until he has the end of the canula fixed against the spot where he intends to make the perforation. After withdrawing the stylet and emptying the bladder, the canula should be tied in by means of tapes, and left for a few days until means can be taken to restore the passage through the stricture, when it must be withdrawn and the aperture left to close. In performing this operation the surgeon perforates the bladder in that portion of its fundus which is uncovered by peritoneum, being bounded behind by the reflection of the serous membrane, anteriorly by the prostate, and on either side by the vesiculæ seminales. In order to avoid wounding any of these structures, he should keep strictly in the mesial line, and puncture immediately behind the prostate.

This operation has the advantage of being far easier of performance than the last, and may doubtless occasionally be required in those very rare cases of

retention from stricture in which there is no sign of abscess or extravasation in the perineum, in which the urethra appears not to be dilated behind the stricture, in which the prostate is not enlarged, and in which, under chloroform, and with patience, a catheter cannot be got into the bladder, a combination of circumstances that will but very rarely indeed occur to a surgeon skilled in the use of his instruments.

2d. *Extravasatiou of urine.*—In consequence of the ulceration or disorganization of the coats of the urethra, this canal may give way behind the stricture, and the urine become infiltrated into the surrounding tissues. The part of the urethra that gives way is invariably the membranous portion of the canal, just anterior to, or between the layers of the triangular ligament, where it is weak, being least supported by surrounding structures, and usually most dilated and attenuated by the pressure to which it has been subjected. This circumstance is a strong argument in favor of the opinion that stricture of the urethra never occurs at or behind the deep perineal fascia; did it do so, we should necessarily have extravasation of urine in a deeper situation than we do. Were it possible for the urethra to give way altogether behind the deep perineal fascia, the urine would become effused into the cavity of the pelvis. But as it is, the connection of the triangular ligament with the rami of the pubes and ischium prevents the extension of the infiltrated urine in that direction, and the manner in which the superficial fascia of the perineum is connected with the deep fascia uniformly causes the fluid to take a course forwards into the perineum, scrotum, and upwards upon the external organs of generation, the groins, and the anterior abdominal wall; ascending contrary to its gravity rather than soaking back into the more dependent parts of the body, as it would do, were it not for the particular connection of the fasciæ that has just been alluded to. I have, however, known the superficial fascia to give way, and the urine then gravitating backwards give rise to extensive sloughing in the ischio-rectal fossæ and about the nates, denuding the rectum.

The effects of urine that has become acrid and concentrated by long retention are most deleterious upon those tissues with which it comes in contact. The vitality of whatever portion of cellular tissue it infiltrates is immediately destroyed by it, the tissue becoming converted into a kind of putrid stringy slough, intermixed with and soddened by a quantity of fetid dark-colored acrid pus and urine. The ravages of extravasated urine are often extensive; the urethra giving way suddenly behind the stricture, the fluid is driven with all the force of the vital and physical contractility of the over-distended bladder into the perineum, and thence rapidly finds its way through the scrotum upwards. In other cases, again, the extravasation occurs more slowly; a few drops appear first of all to escape from the urethra through a small rent or ulcer in it; these give rise to inflammation in the surrounding structures, by which the progress of the extravasation is for a time limited. It is especially upon the cellular tissue of the scrotum that the effects of the extravasation manifest themselves in their full intensity, causing great distension and rapid sloughing of it. The skin speedily participates in this action, becoming of a dusky-red or purple color, and then falling into a state of gangrene. In this way the testes may become denuded, and the cords exposed. It is remarkable, however, if the patient survive these destructive effects, with what rapidity the reparative action goes on in this region. It is seldom that infiltration extends higher than the groins, or the anterior portion of the abdominal wall; but it may run up as high as the costal cartilages before proving fatal.

When the extravasation is deep, the urethra being opened between the layers of the triangular ligament, the patient experiences a sensation as if something had given way in the perineum, with much throbbing and pain; there may be but little swelling for a day or two, but then a doughy diffused intumescence takes place, with rapid extension forwards. When the rupture is altogether

anterior to the deep perineal fascia, then rapid swelling and infiltration take place, partly urinous, partly inflammatory, of the scrotum and penis; these parts become enormously distended, œdematous, crackling, and emphysematous, with the local signs that have already been mentioned. The constitutional disturbance is always considerable; at first of an irritative type, but speedily followed by asthenic and typhoid symptoms, by which the patient is at last carried off.

The *treatment* consists in making a free and ready outlet for the urine as early as possible. This should be done as soon as the extravasation is known to have occurred, by a deep incision into the middle of the perineum. So soon as any pain and throbbing, with diffused swelling, occur in the perineum, the surgeon should introduce his left index finger into the rectum, so that the gut may not be wounded, and then pushing a long sharp-pointed bistoury deeply in the raphe of the perineum, cut upward to a sufficient extent into the extravasation, and in the direction of the urethra. A catheter should then, if possible, be introduced and secured in the bladder; in this way no further effusion can occur, an outlet will be afforded to matters already effused, and the greater part of the urine will commonly be found to escape after a time by the aperture thus made. Should the case not be seen until extravasation has spread widely, a free incision should not only be made into the perineum, but also into the scrotum on either side of the septum, into the penis, and wherever else swelling is observed. The sole chance of safety for the patient lies in making these free incisions, through which the parts may, to a certain extent, empty themselves. However extensive the infiltration and serious the mischief may be, we need not despair of the patient if a free outlet can be obtained for the acrid and putrescent urine and effused matters, and in order to secure this, the infiltration must be followed by incisions as high as it extends. The parts must, at the same time, be covered with chlorinated and yeast poultices, and the constitutional powers of the patient must be supported by good nourishment and a sufficient supply of stimulants.

If the patient survive the immediate impression upon the system produced by the gangrene and the urinary infiltration, he must be prepared to go through a severe trial to his constitutional powers, in the separation of the sloughs, the profuse discharge, and other sources of irritation that are set up. During this period he will require abundant support; the brandy-and-egg mixture, ammonia and bark, with any nourishment that he can take; and much attention should be paid to the removal of the sloughs, the giving a ready outlet to the discharges, and to keeping the patient as clean and as free from all local irritation as possible.

3d. *Urinary abscess* may be considered in many cases as a limited effusion of urine mixed with pus, and circumscribed by plastic matter that is deposited in the tissues with which the urine comes in contact. It is generally occasioned by the irritation of the passage of instruments, but may arise simply as the effect of stricture, or from inflammation of some of the urethral follicles. From some cause of this kind a small abrasion or aperture forms in the urethra, a drop or two of urine escapes into the subcutaneous cellular tissue, this becomes bounded or circumscribed by plastic deposit around it, so that extravasation does not occur. Such an abscess as this may form at any part of the urethra, but it is most frequently met with in the perineum, appearing to take its origin from the bulb or membranous part: such an abscess is rarely dangerous, but is chiefly of consequence by being commonly followed by urinary fistula.

A urinary abscess is indicated by the formation of a small, somewhat circumscribed, hard, and painful tumor, situated in the neighborhood of the urethra. It is usually unattended by constitutional disturbance, unless it attain any considerable bulk, when some pyrexia may ensue. It is principally in the perineum that it attains any degree of magnitude, then constituting a perineal abscess, characterized by a deeply-seated, hard, tense tumor, brawny and without fluctu-

ation; attended by considerable weight and throbbing in this region. It does not readily point, owing to the manner in which it is bound down by the superficial fascia.

In the *treatment* of these abscesses early incision is required; when occurring in the scrotum or anterior to it, the surgeon should wait for fluctuation; but when they are seated in the perineum, he need not do so, making a free incision into the hard, brawny mass, which must then be well poulticed.

4th. *Urinary fistulæ* commonly form in the perineum and scrotum as the result of abscess in these regions communicating with the urethra; occasionally, however, they are met with in other situations, as in the groin, the anterior abdominal wall, or the inside of the thigh. They usually communicate with the bulb, or membranous portion of the urethra, but occasionally occur anterior to this. In number they vary considerably; when occurring in the scrotal and penile portions of the urethra, they are usually single; but when in the perineal, they are often pretty numerous; several apertures being occasionally met with about the perineum, scrotum, and nates. In one case Civiale found as many as fifty-two. Their size also differs considerably, some only admitting the finest probe, whilst others are large cloacæ. In a case recently under my care the patient had a tunnel of this kind in the groin that would readily admit three fingers. They are usually tortuous, elongated, and narrow, sometimes constricted externally and more widely dilated behind. The surrounding parts are greatly condensed, the whole of the scrotum and penis enormously enlarged, indurated, and almost cartilaginous in structure. The urine may escape almost entirely through them, scarcely any being discharged through the urethral orifice; or there may be but a slight exudation from the fistulous openings.

The *treatment* of urinary fistula varies according as it is complicated with stricture, and as it is situated in the anterior or posterior parts of the canal.

If there be a stricture, this, as the cause of the fistula, will require removal either by dilatation or the perineal section. If the stricture is not very tight and hard, dilatation commonly succeeds; the instrument being introduced every second or third day, until the urethra is dilated to its normal size, when the fistulous tracks will in many cases close. In some instances, however, the frequent introduction and withdrawal of the catheter is a source of irritation, and then it had better be left in. When this practice is adopted a moderate sized elastic catheter should be used. If this be too small, the urine will flow between it and the sides of the urethra, and thus escape through the fistulæ; if too large, it stretches the urethral orifice of the fistula injuriously.

If the stricture be very tough and irritable, the better plan is to perform urethotomy at once, as in this way we remove all obstruction and give free exit to the urine, which instead of escaping by tortuous and sinuous passages, finds its way out readily through the new aperture that has been made.

The fistulæ, especially if small and recent, will sometimes heal kindly enough after the removal of the obliteration, but if extensive, old, and cartilaginous they are of course little disposed to take on reparative action; and although the cause that in the first instance gave rise to them may be removed, yet they constitute an independent affection which requires special treatment for its cure.

The special treatment for urinary fistula, must vary according to the size of the canal, but more particularly with regard to the part of the urethra with which it communicates; whether it is a *perineal*, *scrotal*, or *penile* fistula.

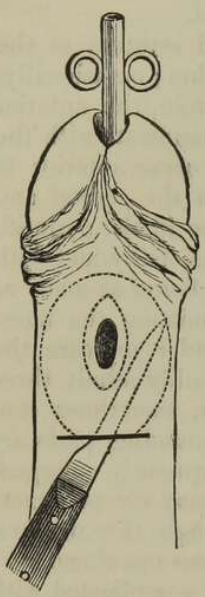
If the fistula is *perineal*, and of small size, a probe coated with melted nitrate of siver, or a wire made red-hot in the ordinary way, or by the galvanic current, and passed down it occasionally, may cause its contraction. If large, a gum-catheter should be kept in the bladder, and the edges of the fistula freely rubbed with the nitrate of silver, or deeply pared and brought together by quilled sutures.

When the fistula is *scrotal* it often requires to be laid open, and to be made

to granulate from the bottom, when it may be found to communicate with large sloughy and ill-conditioned cavities in this situation.

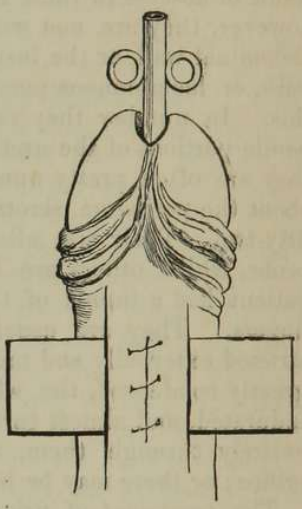
When *penile*, the fistula is usually much more troublesome to heal, its edges are thin, and the track is short and shallow.

Fig. 347.



Urethroplasty may in such cases be advantageously practised. Operations of this kind require for their success very careful management and minute attention to detail; they very commonly fail in consequence of a small quantity of urine or of mucus escaping through the wound, and thus interfering with union of its lips.

Fig. 348.



Urethroplastic operations must be varied according to the situation and the size of the fistula. In all cases a full-sized gum catheter should be passed into the bladder and properly secured there. It should be left without a plug, so that no distension of the bladder, and consequent likelihood of escape of urine between the urethra and the instrument may take place. In order to prevent urinous diffusion over the integuments of the penis and scrotum, a vulcanized india rubber tube should be attached to the end of the catheter, by which means the flow of the urine is directed away from the patient.

If the fistula be in the perineum or scrotum, the parts around being thickened, and indurated, its closure may often be attained, by freely and deeply paring the edges, and then bringing them together with the quilled suture.

When the fistula is penile, there is not sufficient thickness of parts for ready union. In these cases Nélaton has recommended the following operation, which I have successfully practised. The edges of the fistula having been pared, the skin around to the extent of about one inch must be dissected up subcutaneously (fig. 347) through an opening made below the fistula, the edges of which must then be brought together by a few points of suture. The displacement of the skin causes granulations to spring up by which the fistula is closed. This procedure may sometimes be advantageously modified by paring the edges of the fistula, making lateral incisions, and then passing across but underneath the flap a slip of india rubber to prevent contact of the urine disturbing the adhesions (fig. 348).

URINARY VAGINAL FISTULÆ.

Preternatural communications between the urinary passages and the vagina commonly arise from injurious pressure upon and consequent sloughing of the anterior wall of this canal, to a greater or less extent during parturition. They may, however, occur from idiopathic abscess, or from malignant disease involving these parts.

Urinary vaginal fistulæ are essentially of two kinds, according as the communication is established between the urethra or the fundus of the bladder and the vagina. Hence they may be divided into *urethral* and *vesical*.

The *urethro-vaginal fistulæ* are, so far as my observation goes, of most common occurrence, and this is readily explained by the fact that the urethra passes along the anterior aspect of the vagina for some distance before it terminates in the bladder, and occupies that portion of the vaginal wall that is most likely to be compressed during labor, under the arch of the pubes. These fistulæ are usually of small size and linear. The *vesico-vaginal fistulæ* establish a communication between the neck or fundus of the bladder and the vagina. They are consequently situated further back than the other, and are usually larger and more ragged.

The existence of a urinary fistula in the vagina, is always a source of serious discomfort and distress to the patient. The dribbling of urine through the preternatural aperture is generally continuous, although if this be situated far back behind the orifices of the ureters it might be somewhat intermittent, a flow taking place as the lower portion of the bladder fills. The incontinence of urine thus produced, gives rise to irritation and excoriation about the external parts, and occasions a strong ammoniacal odor to hang about the patient.

The precise seat and extent of the fistulous opening, are best ascertained by examination with a bivalve speculum, or with a conical one having a slit made at its upper part, at the same time that the introduction of a bent probe, or of a female catheter into the urethra, will guide the surgeon to the artificial opening in the urinary passage.

Treatment.—The cure of one of these vaginal fistulæ can only be effected by causing a coalescence of their sides. When small and urethral, this may sometimes be effected by touching the walls of the aperture with the electric cautery or a red-hot wire, introduced between the blades of an open speculum, and repeating this application once a fortnight or three weeks, until a cure is effected.

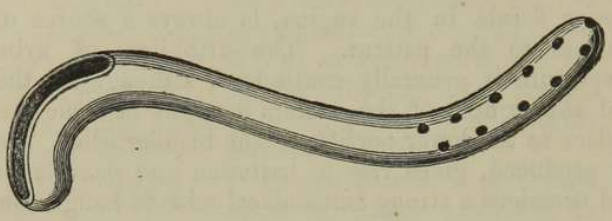
When the fistula is larger, and especially when vesical, its cure can only be accomplished by paring the edges, and bringing them together with sutures, and thus attempting to procure union by the first intention. In effecting this, however, two difficulties present themselves:—The sutures either cutting their way out too soon, or the trickling of urine between the freshly pared edges, interfering with adhesion. In order to overcome these difficulties, a variety of ingenious contrivances have been introduced by different surgeons. The most useful of these are, in my opinion, Mr. Brookes' bead sutures, and the "clamp suture" of Dr. Marion Sims.

The treatment recommended by Dr. Marion Sims leaves little to be desired in the management of these cases; Dr. Sims uses a suture of fine silver wire, well annealed, which after being introduced across the lips of the wound, is properly fixed to leaden or silver cross bars; these sutures are introduced by passing a silk thread by means of a nevus or corkscrew needle, about half an inch from the freshened edge of the fistula, and bringing it out through a corresponding point on the other side of the fistula, without having transfixed the mucous membrane of the bladder. As many threads as necessary having been passed in this way, a piece of silver wire about eighteen inches long is attached to the silk, which is then drawn out, leaving the wire to occupy its place, so that its centre corresponds to the fissure, and both ends hang out of the vagina. The uppermost free ends are then passed through holes made in a narrow silver or leaden bar, and clamped by having split shot fixed upon them in the same way as is done on a fishing line. The unclamped wires are now drawn down until the bar is pulled close to the upper suture holes, and a second clamp is then fixed to these ends, and is pushed up against the lower suture apertures. In this way the edges of the fistula are brought and held together by a clamp on either side, which may be allowed to remain in from seven to ten days. These may then be removed by clipping off the flattened shots from the anterior

clamp, which is thus detached from its bed. The posterior one, with the wires attached, may then be hooked up, pushed backwards, and lifted out of the vagina with forceps.

In the after-treatment, especial attention is required; and here the great point is to prevent the contact of the urine with the edges of the fistula. With this view a catheter should be introduced, and worn in the bladder, so that no urine may collect in this organ. For this purpose, Dr. Sims has invented a very ingenious catheter, represented in the annexed cut (fig. 349), which may be worn with more comfort, and with less chance of slipping than the ordinary instrument. After the patient has been put to bed, and the catheter introduced, a full opiate should be given, and continued throughout the treatment, with the view of preventing the action of the bowels, a point on which Dr. Sims lays much stress, and to which the success of his operations may be in a great measure attributed. It is very seldom that they are required to be opened for ten or fifteen days, provided the patient be kept on a rigid diet. During this treatment the catheter may be removed once or twice a day, in order to be cleansed and to be kept free from phosphatic or mucous accumulations, and free ablutions of the external genitals by sponge or syringe and warm water should be practised during the whole of the treatment. After the removal of the sutures, Dr. Sims advises that the catheter should be continued, and great care exercised not to move too soon, lest the weak cicatrix be strained.

Fig. 349.



More recently a very simple and successful mode of closing these fistulæ has been invented by Dr. Bozeman, of Alabama, by what he terms the "button suture." After paring the edges of the fistula, and passing silver wires across in the usual way, he draws the parts together by passing both ends of the wire

Fig. 350.

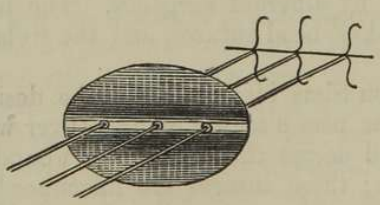
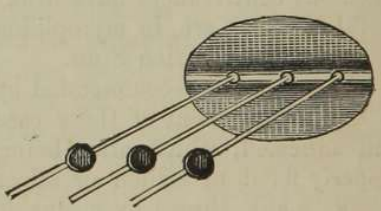


Fig. 351.



through an aperture in a steel rod, which, being carried along them, closes the opening. A thin silver or leaden plate, "the button," properly perforated down the middle, is then slipped along the wires so as to cover the fistula (fig. 350), and split shot having been pushed along their free extremities, are pressed tightly against the button, the wires are then properly nipped, and the apparatus is left on for about ten days (fig. 351).

TUMORS OF THE URETHRA.

Small polypoid tumors are not unfrequently met with inside the urethral orifice. They have occasionally a gonorrheal origin, though they commonly arise irrespective of such disease. They are always very vascular, and are most frequently met with in or around the female urethra, where they are of a bright red color, have a florid hue, bleed freely when touched, and are composed of a

spongy kind of erectile tissue; they are commonly conoidal or oval, encircling the urethral orifice on one side, or even forming a complete zone around it. They grow slowly, and seldom attain a larger size than that of a raspberry. They are not unfrequently accompanied by a vast deal of sympathetic irritation, great pain in micturition, attended by an admixture of mucus or pus in the urine, uneasiness of the lower part of the abdomen, and often aching in the loins.

These vascular tumors are far less frequent in the male than in the female urethra. When they occur in men, they usually constitute a small granular florid mass inside the orifice of the canal.

When seated in or around the female urethra, these tumors not unfrequently give rise to very great and continuous irritation; much pain during and after making water, radiating through the whole pelvic region, and in fact many of the symptoms of stone; so that patients laboring under this affection are often sounded on the supposition of there being calculus.

Vascular urethral tumors may be removed in four ways: — by *excision*, *ligature*, *caustics*, or *the actual cautery*.

1st. *Excision.* When situated within the male urethra, they should be snipped off with a fine pair of curved scissors. When situated in or around the female urethra, if of small size and pediculated, they may readily enough be removed by the scissors or dissected away, the canal of the urethra being encroached upon as little as possible. This operation is, however always attended or followed by very considerable and continuous arterial hemorrhage, which has even in some instances been of a fatal character. Hence when the tumor is of large size, and the patient weakly, excision should be practised with much caution. If it be done, the hemorrhage may be arrested by the introduction of a catheter into the urethra, and by firm pressure on the bleeding surface by means of a pad of lint supported by a T bandage.

2d. *The Ligature* is not a convenient mode of removing these growths, being difficult of application, very painful and tedious.

3d. *Caustics*, more particularly the strong nitric acid or the potassa cum calce may be very conveniently employed where the tumor is of small size and very vascular. In applying them, the upper wall of the canal must be protected by a broad director introduced along it.

4th. *The actual Cautery* is the most convenient agent for the removal of these growths from the female urethra. By it they are at once destroyed without hemorrhage, and the eschar that is formed protects the subjacent raw surface from the irritation of the urine. If situated deeply within the urethra and of small size, the galvanic cautery or a red-hot wire will most easily reach them; but if at or around the orifice, I always employ a small olive-shaped cautery. During its application the surrounding parts must be protected from the action of heat by spatulæ, and the urethra by a director or silver catheter, which should be retained after the operation.

CHAPTER LVIII.

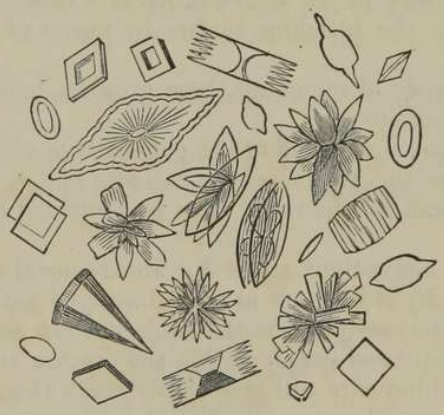
STONE IN THE BLADDER

THE urine is liable to the deposit of various solid matters, which when amorphous and impalpable are termed *sediments;* when crystalline, they constitute *gravel*, and when concrete, form *calculus or stone.* These deposits, whatever form they assume, are always the result of constitutional causes; and these con-

stitutional conditions giving rise to them are commonly called *diatheses*. Of these, surgeons usually recognize three: the *lithic*, *oxalic*, and the *phosphatic*; besides these, however, others doubtless exist, the precise characters of which have yet to be determined.

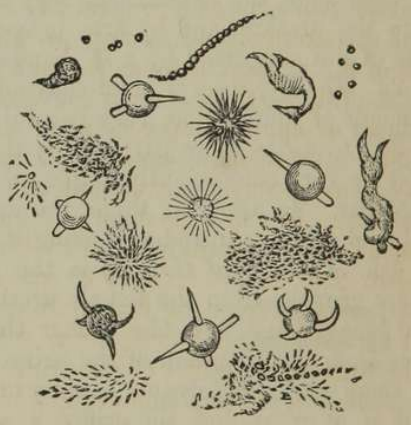
The *lithic acid diathesis* chiefly occurs in individuals of robust habit of body and florid looking, who have lived high and suffer from irritable gastric dyspepsia. It is often associated with a gouty or rheumatic tendency, or with some of the more chronic forms of skin disease, especially psoriasis. It is characterized by scanty and acid high colored urine, which deposits on cooling two kinds of sediment, a yellow and a red. According to Lehmann, these sediments consist of urate of soda; but Golding Bird, and, I believe, most of the chemists in this country, regard them as lithates of ammonia. The yellow sediment, containing an admixture of the coloring matter of the urine, is usually dependent on slight disorder of the digestive organs and skin, coming and going under the influence of very trivial causes. The red sediment, owing its color, according to Bird, to an admixture of purpurine, a highly carbonaceous ingredient, and indicative of imperfect assimilation, is met with in persons of full habit, who live too freely. A variety, or rather an admixture of these sediments, constitute the *lateritious deposit*, so common in gout and rheumatism. The red sand or gravel is a crystallized variety of the lithic acid sediment. It may be compared, in general appearance, to cayenne pepper, and under the microscope presents the characters seen in fig. 352. It is not unfrequently met with in

Fig. 352.



Lithic Acid.

Fig. 353.



Lithate of Ammonia.

children of a strumous habit, who are allowed more animal food than they can well assimilate. Occasionally crystals of lithic acid are found intermixed with these deposits, presenting the characters figured in 352.

The calculi that occur in this diathesis are of two kinds; the lithic acid, and the lithate of ammonia. The lithic acid calculus is usually of small or moderate size, varying from a pin's head to a pigeon's egg; it is oval, somewhat compressed and flattened, smooth on the surface, and of a fawn color. On section it is seen to be laminated and to present various shades of a light brown or fawn tint. The lithate of ammonia calculus is of very rare occurrence; when met with, it is chiefly in children, and is composed of concentric rings, having a fine earthy appearance, and being clay-colored.

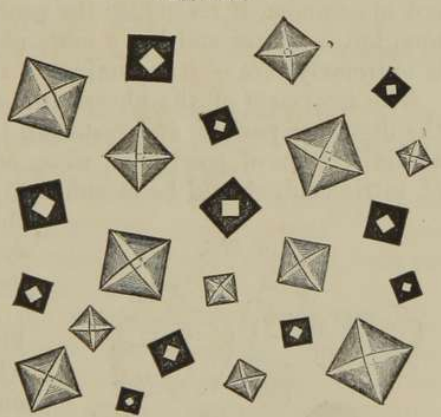
The *treatment* of the lithic acid diathesis must be directed to the removal of the prime causes of this condition, viz., mal-assimilation, defective oxygenation of the blood, and the ingestion of too large a quantity of stimulating food. All this may be remedied by attention to ordinary hygienic measures; the patient

must live sparely, should avoid fermented liquors, especially red and effervescent wines, and abstain from sweets, pastry, &c. He should take plenty of out-door exercise, and keep the skin in healthy action by warm or vapor bathing, and the use of horse-hair gloves. The bowels must also be carefully regulated by means of saline and other aperients, with occasional alterative doses of Plummer's or blue pill; to which, if the constitution be peculiarly rheumatic or gouty, some colchicum may advantageously be added. A very good aperient for general use in these cases, is ʒj of Rochelle salt in ℥iss of the compound decoction of aloes, taken at night or early in the morning; or a dessert-spoonful of the following powder every morning: ℞ Pulv. Rhei, ʒss., Potass. tartrat. ʒj., Magnesiæ ustæ, ʒij., Pulv. Zingiberis, ʒj.; f. pulvis. The patient may also be directed to drink some of the natural alkaline waters, as those of Vichy or Fachingen. The Vichy waters, containing as they do a large quantity of carbonate of soda, with free carbonic acid, are extremely serviceable for the correction of this diathesis. If they cannot be procured, a very good alkaline drink consists of ℈j of bicarbonate of potass and 5 grains of nitre dissolved in a tumbler of cold or tepid water, to which about 5 grains of citric acid, or a table-spoonful of lemon-juice may be added, and taken early in the morning or in the middle of the day.

When lithic acid calculus has actually formed, it is not well to give the alkaline remedies too long, or in too large quantity, lest the stone rapidly increase in size by becoming encrusted with phosphates.

The *oxalic diathesis* is characterized by the formation of oxalate of lime in the urine. It generally occurs in individuals in whom there is defective assimilation, dependent upon exhausted nervous energy, arising from over work, mental anxiety, or venereal excesses. The patient is usually pale and hypochondriacal, suffers from dyspepsia, acidity of stomach, and disturbed sleep. In these cases there is often loss of sexual power; a state of debility of the generative organs, connected either with the want of erectile vigor, or too speedy emissions. The urine is usually very pale, abundant, and acid, and there is heat and smarting during its passage along the urethra. In this diathesis there is no sediment or gravel properly speaking, but the crystals float in the urine, subsiding however when it stands, but not occurring in sufficient quantity to constitute a true sediment (fig. 354).

Fig. 354.



Oxalate of Lime.

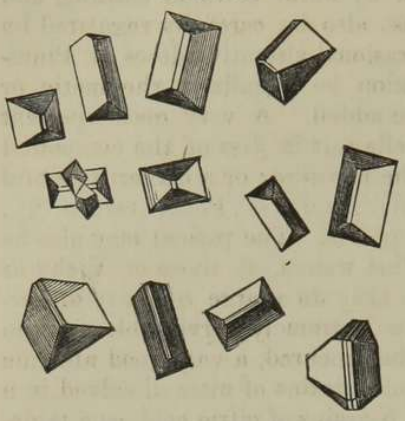
The oxalate of lime or mulberry calculus is usually of a dark brown or almost black color, moderate in size, being seldom larger than a walnut, and round; it is always rough, tuberculated, and sometimes almost spiculated on the surface.

In the *treatment* of this diathesis, when there is no calculus, it is necessary to put the patient upon a light and nourishing diet, especially fish, as recommended by Dr. Bird; cautioning him to avoid sweets and all fermented liquors, with the exception of a moderate quantity of brandy. Tonics, more particularly the mineral acids, iron, zinc, and quinine may be given, and the residence, if possible, changed for a time to a warm climate. When calculus is formed there is, owing to its roughness, and the irritable state of the patient's nervous system, usually a good deal of pain experienced in the region of the bladder, requiring the free administration of opiates.

The *phosphatic diathesis* chiefly occurs in old persons, or in those who are

prematurely aged, with a broken constitution and an anemic condition of the system. In this diathesis the sediment and calculi may occur in three distinct forms.

Fig. 355.



Ammoniaco-Magnesian Phosphate.

1st. *Triple or ammoniaco-magnesian phosphate.*

2d. *The Phosphate of Lime*, and

3d. *The mixed phosphates, consisting of a mixture of the preceding varieties.*

The triple phosphates (fig. 355) usually occur in urine that is copious, pale and barely acid, sickly to the smell, and soon decomposing and becoming very offensive. In other cases it is dark, alkaline, and mucous. This condition especially occurs in old people, is associated with much debility, irritability of mind, pallor, and anemia.

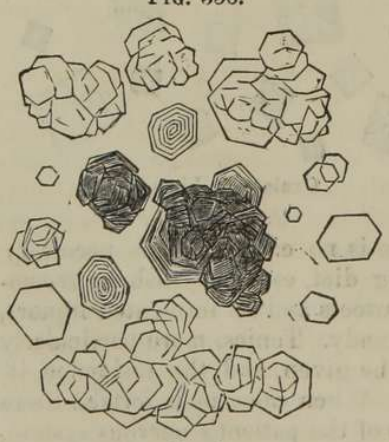
The phosphate of lime sediment is not of such common occurrence; it usually occurs in pale, and offensive, readily putrescent urine, mixed with much mucus, and in some cases apparently produced by the mucous membrane of the bladder.

The mixed phosphates commonly occur after injuries of the spine as the result of general impairment of the health, or in advanced cases of prostatic disease. They are occasionally met with in large quantity, forming a kind of mortar-like sediment in the bladder.

The phosphatic calculi are very common, the most frequent is the mixed, or fusible calculus as it is termed, on account of the ready way in which it melts when exposed to heat. This calculus is friable, laminated, and has a chalky, or earthy look. The calculus composed of phosphate of ammonia and magnesia is not so common, it resembles the preceding pretty closely in its general characters, but is whiter and has a more chalky look; the phosphate of lime calculus is extremely rare — it is laminated and harder than the other varieties.

The *treatment* of the phosphatic diathesis consists principally in improving the digestive powers, and restoring the general strength of the patient by the administration of good food, wine, or beer. The exhibition of tonics, especially of nitric acid, should be attended to, and exercise in the open air enjoined. As there is usually much pain and irritability of system in this diathesis, opium may advantageously be administered.

Fig. 356.



Cystine.

Besides the calculi mentioned, various other kinds of concretions form in the urine, each of which doubtless represents a diathesis; the characters of which, however, are not so distinctly marked, or so well recognized as those that have just been described.

Cystine is one of the rarer forms of morbid product occasionally met with in the bladder. It differs from all other ingredients, in containing a large quantity — about 26 per cent. — of sulphur. It is very rarely seen as a sediment in the urine, but when it occurs in this form it presents the microscopic characters seen in fig 356, being composed of hexagonal laminæ. Calculi containing cystine have occasionally been met with. Dr. Golding Bird states in his work, that in Guy's Hospital Museum there are eleven composed of this peculiar

animal matter; and in the Museum of University College we have some good specimens. Cystine in calculus has a peculiar yellowish or greenish and waxy look, very different from any other ingredient met with in urinary concretions.

Xanthine, uric, or xanthic oxide, was first noticed by Dr. Marcet, and has since been observed by Laugier, Langenbeck, and others. It is of extremely rare occurrence, and has only been found in a few recorded instances in the form of calculous concretions. These have generally been of small size, with the exception of the one removed by Langenbeck, which weighed 388 grains. For the chemical characters and constituents of this substance I must refer to Dr. Bird's work.

Carbonate of lime has occasionally been met with as an amorphous powder in alkaline or very faintly acid urine. I am not aware of any calculus of this composition having ever been found, but Dr. Bird states that he has detected carbonate of lime as forming a distinct stratum in some phosphatic calculi.

Structure of calculi.—Calculi, though sometimes composed throughout of the same deposit, are not unfrequently made up of layers or strata, differing in chemical composition from one another, and then usually go by the name of *alternating calculi.* Most frequently the nucleus consists of lithic acid or lithates; next in the order of frequency comes the oxalate of lime; and then the phosphatic nucleus. It is very seldom that the nucleus is absent; but concretions have occasionally been met with in which none could be detected, or in which it was even replaced by a cavity. The nucleus is usually as nearly as possible in the centre of the calculus, and is generally pretty regular in shape; occasionally, however, it is branched or curiously radiated, and then the concretion generally affects a corresponding outline. Calculi containing two or three nuclei have sometimes been found, consisting probably of an equal number of concretions agglomerated together.

The body of a calculus having the uric acid nucleus is usually composed of some of the lithates; but not unfrequently these are incrusted by a deposit of phosphates. In other instances again, the body may be wholly composed of some of the earthy phosphates, which more rarely alternate with the oxalate of .ime or the triple phosphates.

An oxalate of lime nucleus usually has a body of the same constitution; but in some cases it is incrusted by phosphates or urates. When the nucleus is phosphatic, the concretion is always of the same constitution.

Vesical calculi may be formed either in the kidneys or the bladder; those that contain a nucleus of the urates or oxalates are probably renal in their origin; whilst those that have a phosphatic nucleus are usually vesical from the first; renal nuclei being rarely met with of this composition.

Renal calculi.—When a stone forms in the pelvis of the kidney, it usually gives rise to pain in the loin. When of small size it may descend into the bladder with but little suffering to the patient; but, if large enough to irritate the ureter and to pass with some difficulty, it then gives rise to a peculiar train of symptoms that will immediately be described. In some cases the calculus attains a very large size, occupying the whole of the pelvis of the kidney, extending into the calices and ureter, and being moulded, as it were, to the shape of the parts amongst which it lies; it then gives rise, by its pressure, to absorption of the substance of the kidney, and occasions, by the magnitude that it attains, excessive pain and irritation in this region, the patient usually eventually dying, worn out by constant suffering, and the irritation of incurable kidney disease. In some instances, stone in this situation has been known to give rise to abscess in and around the kidney, and has even been discharged through an aperture in the lumbar region.

In those cases in which a renal calculus descends into the bladder, the patient is seized with pain in the loin that has been the seat of previous irritation. This pain is usually of the most agonizing character, extending into the cord

and testis and down the thigh of the affected side. There is retraction of the testicle, with constipation and vomiting; frequently accompanied by the passage of scanty, high-colored, and bloody urine, and great constitutional disturbance. This pain usually continues of a somewhat remittent character, until the calculus enters the bladder, when, unless expelled, it gives rise to a peculiar train of symptoms, depending on its presence in that organ.

During the descent of a renal calculus, which always occupies many hours, and perhaps some days, the patient should have full doses of opium administered, be put into a warm hip-bath, and have mustard poultices applied to the loin, or be cupped in this situation, if necessary; the bowels should also be thoroughly emptied by enemata. It is well to bear in mind that a somewhat similar train of symptoms to that induced by the descent of the calculus, may be excited by some forms of irritation or flatulent distension of the cœcum and descending colon, which will require appropriate treatment.

Vesical calculi.—Though vesical calculi occasionally owe their origin to the descent of a stone from the kidney, yet it not unfrequently happens that there is no evidence of their coming from such a source, but every appearance of their being deposited in the bladder; a nucleus being originally formed in this viscus by the aggregation of some sabulous matters, around and upon which fresh deposits take place, until a true calculus is formed. In some instances, vesical calculi have been found deposited upon, and incrusting foreign bodies accidentally introduced into the bladder, such as a piece of straw, a pin, a bit of bougie, &c.

The number of calculi in the bladder varies considerably; most commonly only one is encountered; but in about one-fifth or one-sixth of the cases operated upon, several will be found: from two to six or eight are by no means uncommonly met with. Occasionally several dozens have been detected, and there are even instances on record in which some hundreds of distinct and separate calculi have been found in one bladder. The most remarkable case of this kind is one, in which Dr. Physick removed from a judge in the United States, upwards of a thousand calculi varying in size from a partridge-shot to a bean, and each marked with a black spot. Several calculi may become matted together in one large concretion, as in the annexed representation of a calculus that I removed last year from a child (fig. 357), which is formed of eleven distinct lithic acid calculi soldered together in this way, besides which three others were lodged in the bladder.

Fig. 357.

When there are several calculi in the bladder, the attrition of one against the other usually causes the opposing surfaces to become smooth, thus constituting facets. In some cases, however, the calculi are numerous, and there are no signs of attrition. In a patient of mine who had fifteen calculi in his bladder, all the stones were round, about the size and shape of marbles, without any signs of rubbing.

Calculi have been occasionally known to undergo spontaneous rupture in the bladder, by a kind of concussion against one another, or, as Civiale supposes, by the contraction of a hypertrophied bladder, by which one stone may be broken into a number of fragments. In some instances these have agglomerated together, by the deposit of a quantity of phosphatic matter upon and around them. In other instances the different fragments may each form the nucleus of a fresh calculus, so that the bladder may afterwards contain several concretions.

The size of calculi varies from that of a hemp-seed or a pin's head to a concretion of immense magnitude. One of the largest with which I am acquainted is a calculus removed by the high operation by Dr. Uytterhoeven of Brussels, which I saw some time ago in his possession, and of which he has been obliging enough to give me a cast; it is of pyriform shape, and measures 16½ inches in

its longest circumference, and 12½ inches round at its broadest part, being 6½ inches long, and about 4 wide. In the celebrated case of Sir W. Ogilvie, Cline attempted, but failed, to extract a calculus measuring 16 inches round one axis and 14 round the other. It weighed 44 ounces, and must have been about the size of Dr. Uytterhoeven's. These enormous concretions are happily rarely met with, the usual size of stones removed by operation being from about one to two inches in the longest diameter, somewhat narrow, and perhaps flattened.

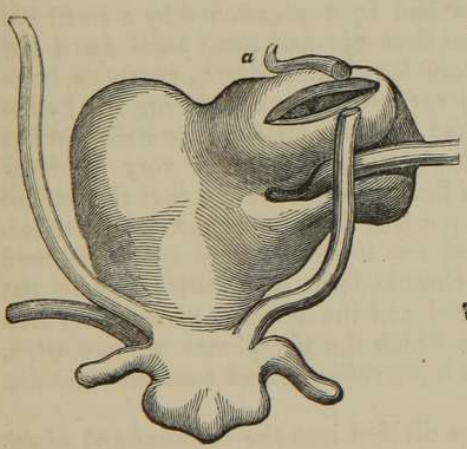
The weight of calculi commonly varies from a few grains to several ounces; the commonest size is from three drachms to about an ounce or two in weight, occasionally from three to six; from this they may range upwards until several pounds are reached. Thus, in Cline's case the stone weighed 44 ounces, Deschamps saw one of 51 ounces, and Morand one weighing 6 lbs.: none of these admitted of removal. The largest calculi are usually composed of phosphates, in greater part if not in whole.

The hardness of calculi varies considerably; the oxalate of lime is the hardest; the lithates come next in consistence, and are often very hard, though brittle; the phosphates are always comparatively soft and friable.

The shape of calculi presents great variety; most commonly, however, they have an ovoid figure. Concretions of urate of ammonia and uric acid are generally pretty regularly ovoidal, smooth, and disc-like. Those composed of oxalate of lime are usually somewhat globular or square-shaped, and generally rough, nodulated, or spiculated upon the surface. The phosphatic calculi present usually the most irregular outline; most commonly, it is true, they are ovoid or globular, but not unfrequently branched as if moulded to the interior of the kidney, constricted, or of an hour-glass shape. The cystine calculi are generally tolerably oval and regular in outline.

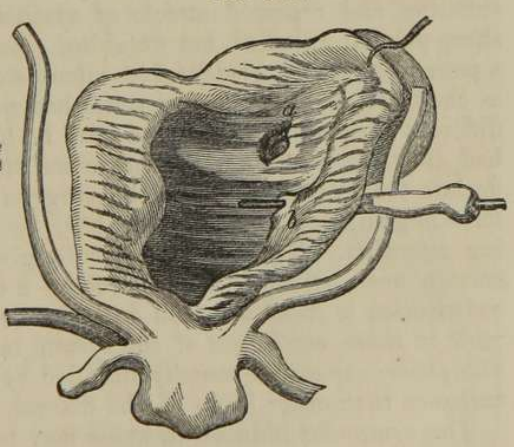
Most frequently calculi lie loose in the bladder; but occasionally they may be fixed in this viscus, owing either to their being encysted, and then lying in one of the sacculi that have already been described within the walls of the bladder (figs. 358 and 359), or by being fixed in and embraced by one of the ureters, and in other cases by being deposited upon, and partly included in fungous growths.

Fig. 358.



Exterior of bladder containing an encysted calculus at *a*.

Fig. 359.



Interior of the same bladder, showing small orifice leading into cyst at *a*, ureter *b*.

The *causes* of calculi are somewhat obscure. There can be little doubt, it is true, that the different forms of concretion are connected with the varieties of diathesis that have already been described, and we may look upon the formation of a calculus as an indication of the existence, in a greater degree of

intensity than usual, of the same causes that, under ordinary circumstances, give rise to sediments or gravel; but why, in particular cases, the aggregation into a calculous mass takes place, it is impossible to say. Age appears to exercise considerable influence upon the production of calculi; for though stone may occur in the bladder at all periods of life, and even, according to Stahl, be congenital, it is certainly more frequent amongst children a few years old, and at advanced periods of life, than during middle age. Mr. Coulson has collected 2972 recorded cases of lithotomy from various sources; of these, 1466 occurred under the age of ten, 731 from eleven to twenty, 205 from twenty-one to thirty, 264 from thirty-one to fifty, and 306 from fifty-one and upwards.

It would appear that in some parts of the world calculus is a far more common disease than in others. It is generally more frequently met with in cold than in warm climates; indeed, in tropical countries I believe the disease is scarcely known. The Negro race also is remarkably exempt from this affection. It is a singular fact that in some parts of the same country calculous disorders are of far more frequent occurrence than in others. Thus it is well known that the inhabitants of the east coast of England and Scotland are peculiarly liable to these disorders, and that in Norfolk, stone occurs with especial frequency; this district furnishing, in all probability, as many cases as the half of the rest of England. In America also, it would appear that the inhabitants of certain states are peculiarly obnoxious to this affection; and I understand that in some districts of Germany the disease may be said to be almost unknown, whilst in others it is of common occurrence. To what these differences are owing it is impossible to say. Peculiarity of race, of constitution, and of diet, with exposure to prevalent easterly winds, have all been assigned as reasons for them, but probably not on very sufficient grounds. Sex influences materially the occurrence of stone, which is far more frequent in the male than in the female.

The *symptoms* of stone in the bladder vary somewhat according as the calculus lies loose in the cavity of the viscus or is encysted. They also vary considerably according to the size and shape of the stone, the condition of the bladder, and the constitution of the patient. Most commonly the severity of the symptoms are in proportion to the magnitude of the calculus. This, however, is not always the case. In a patient whom I recently cut, the most intense suffering and repeated attacks of cystitis had been occasioned by a small but sharp-pointed calculus, not weighing more than ʒj; and some years ago I saw a patient in whose bladder five calculi were found after death, nearly as large as chestnuts, though their presence had never been suspected during life by the different surgeons under whose care he had been for stricture, so little distress had they occasioned. In some cases the symptoms of stone very suddenly declare themselves, and then the surgeon finds on examination that the patient has a largish calculus, which must have been a long time forming without attracting attention. Rough calculi usually give rise to more severe symptoms than smooth ones, owing to their inducing a chronic form of cystitis; and, as the constitution is usually a good deal shattered and the nervous system very irritable in those conditions of the system in which the phosphates are deposited, phosphatic calculi are usually attended by more suffering and constitutional disturbance than other forms of the disease.

The symptoms induced by stone may be divided into the *rational* and *physical*. The *rational* signs, consisting of pain, increased frequency in micturition, the occasional stoppage of the urine, and various morbid conditions of that fluid. The *physical* signs are those by which alone the surgeon can positively determine the presence of the calculus, feeling it with the sound.

The pain in calculus is usually the first symptom that attracts attention; it is not only experienced in the region of the bladder and the perineum, but radiates widely in the course of the sacro-lumbar nerves. The patient complains

of a heavy and dragging sensation in the groins, extending down the outside or back of the thighs, and not uncommonly experienced in the soles of the feet. The penis likewise is the seat of a good deal of uneasiness, frequently of a sharp and cutting pain in the glans. This is especially noticed in children, in whom attention is often attracted to the complaint by their constantly squeezing and pulling the organ to relieve the distress they suffer in it. The pain is much increased by any movement by which the stone is jolted about in the bladder, as in driving, riding, or jumping; and is especially severe in those cases in which cystitis occurs. It is always most severe towards the termination of, or immediately after micturition, as there is then a tendency for the calculus to roll forwards towards the neck of the bladder, where it comes in contact with and is grasped by the most sensitive part of that organ. Hence it is not unfrequent in cases of calculus occurring in children to find that the little patient instinctively lies upon its back or side whilst making water, and thus escapes much of the agony that it would otherwise suffer. In adults in whom the prostate happens to be enlarged, the calculus usually lies in a depression behind this gland, and hence, being prevented coming in contact with the neck of the bladder, occasions less suffering than in other cases.

An occasional stoppage commonly occurs in the flow of urine before the bladder is emptied, owing to the stone being impelled against its neck, and thus blocking up the urethra; but on the patient lying on his back or on his side the stream flows again, the situation of the calculus being changed.

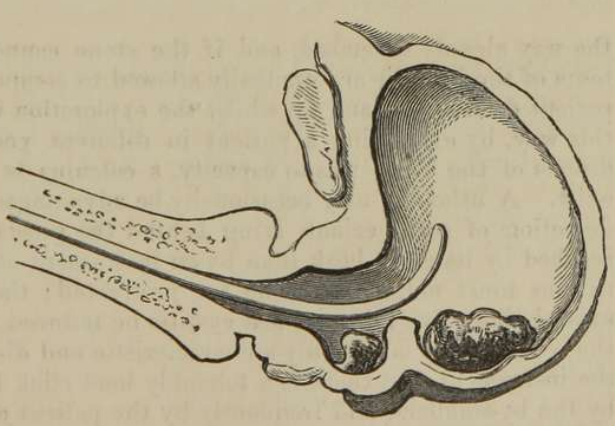
In consequence of the irritation set up in the bladder occasioning chronic inflammatory action of the mucous membrane, there is an increased frequency of micturition. The urine is passed in small quantities, and usually contains some mucus or pus, and is occasionally tinged with blood. The occurrence of blood in the urine of children leads strongly to the suspicion of stone, and should always induce the surgeon to make an examination of the bladder with the sound. If the kidneys are irritated, the urine is commonly albuminous.

As a result of the straining and general irritation about the genito-urinary organs, prolapsus of the anus, accompanied by tenesmus, is by no means uncommon, and in some cases there is very troublesome priapism.

When a stone is encysted, those symptoms that depend upon its being loose and rolling about in the bladder, are necessarily absent; thus there is no stoppage in the water, the urine is seldom bloody, and the pain is not materially increased by jolts and rough movements, though there is weight and pain in the usual situations, and increased frequency of micturition from the pressure and irritation of the calculus.

The existence of stone is finally determined by *sounding* the bladder.

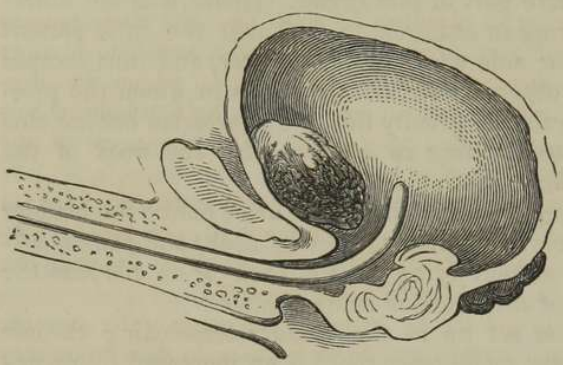
Fig. 360.



A *sound* is a solid steel instrument shaped like a catheter, but shorter in the curve, so that it may explore more thoroughly all parts of the bladder, especially those behind the prostate. It should also have rather a wide and smooth steel handle. The operation of sounding should be conducted as follows: — The patient should lie upon his back on a hard mattress; a full-sized sound well oiled and warmed should then be passed into the bladder; which should, if the patient can retain it, be allowed

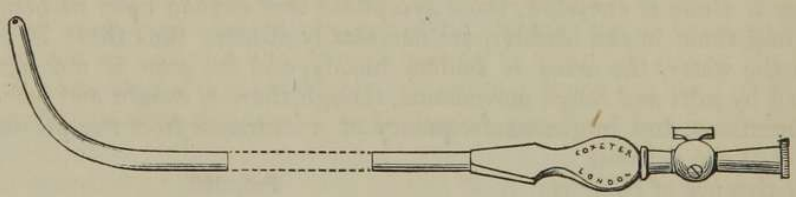
to contain three or four ounces of urine. The surgeon then using his left hand, or crossing over to the patient's right side, whichever he finds most convenient, carefully directs the beak of the instrument towards the back of the bladder, turning it from right to left over the whole of that region (fig. 360); he next draws it forwards on one side as far as the neck, tapping as it were gently with its beak; he repeats the same manœuvre on the other side, and lastly directs the end of the instrument by raising its handle into the lower fundus, which he carefully explores. Should he not detect the calculus in any of these situations, he depresses the handle between the thighs, and tilts up the beak so as to examine the subpubic portion of the organ (fig. 361). In the event of his not meeting with a stone, he may direct the patient to stand up, and then explore the bladder, first upon one side, then on the other. Should the rational signs of stone be well marked, though no calculus be struck, the surgeon must not give a decided opinion in the negative after the first exploration, but should examine the patient again a few days later, with the bladder in different states as to its contents.

Fig. 361.



In making this second examination, I have found it of great service to use a hollow steel sound, by which the organ can be injected or emptied at pleasure (fig. 362). The patient should on this occasion have his bladder injected through such an instrument as this, with four or six ounces of tepid water, so as to distend the organ slightly, and prevent the folds of mucous membrane overlapping any concretion that may exist in it. Its interior is then carefully explored in

Fig. 362.



the way already described, and if the stone cannot then be detected, the contents of the bladder are gradually allowed to escape through the sound, and the patient desired to stand up whilst the exploration is being proceeded with. In this way, by examining a patient in different positions and in different conditions of the bladder as to capacity, a calculus is sure to be detected if one exist. A lithotrite may occasionally be advantageously used as a sound for the detection of small calculi lying behind the prostate, a situation more readily reached by its short beak than by an instrument of larger curve. These examinations must not, however, be too protracted; the time occupied should not exceed above five minutes, lest cystitis be induced. When a stone is struck by the sound, there is not only a characteristic and distinct shock communicated to the instrument, but there is a tolerably loud click heard, which can be detected by the by-standers, and frequently by the patient as well as by the surgeon.

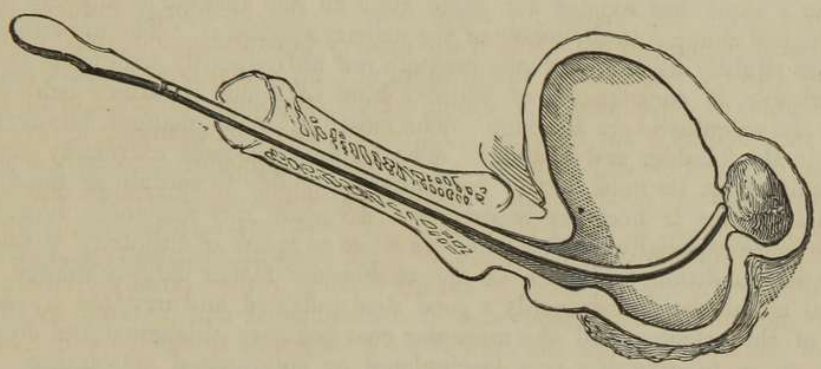
By conducting the sounding properly, the surgeon may usually ascertain not only the existence of a stone, but its size, and hardness; whether it is single, if it be encysted, and the general state of the bladder, all of which it is of im-

portance that he should be acquainted with before undertaking any operation. A good deal of this information may be elicited by the ordinary sound, but some of the points can only be accurately determined by sounding with the lithotrite.

The hardness of the stone may usually be judged of by the more or less clear ringing character of the click; a lithic acid or oxalate of lime calculus giving a sharper sound than a phosphatic concretion.

A calculus may generally be known to be encysted if the sound strikes it at times, but not at others (fig. 363); if the stone always appears to be fixed in

Fig. 363.



one situation; and if the beak of the instrument cannot be made to pass round it, so as to isolate it, but feels a kind of tumor projecting through the walls of the bladder, around or on one side of the point where the calculus is struck.

The fasciculated, roughened, and sacculated condition of the bladder may generally be detected by the way in which the beak of the instrument grates and rubs over the organ.

The size of the calculus is best determined by a lithotrite. It is true that a surgeon may sometimes come to a decision as to the bulk of a calculus by observing the extent of surface along which the sound is in contact with the stone as the instrument is being withdrawn. But a very rough guess only can be arrived at in this way, and I have frequently seen very experienced surgeons deceived in their estimate of the size of a calculus, mistaking perhaps several small ones lying together for one large one. By introducing a lithotrite and seizing the calculus gently between its blades, a correct estimate of its size may always be arrived at.

In order to determine that several calculi exist in the bladder it is sometimes sufficient for the surgeon to feel that the beak of the sound comes in contact with a stone on either side of the organ, or that it can be distinctly insinuated between two concretions. In some cases, however, these points cannot clearly be made out; and then the surgeon introducing a lithotrite and seizing the first calculus that he meets with should hold this between the blades of the instrument, and whilst it is so fixed move it and the lithotrite from side to side, when, if a click is heard and felt, he may be sure of the existence of another stone.

Errors occasionally occur in sounding; the surgeon mistaking a hardened and fasciculated bladder, having its ridges perhaps incrusted with sabulous matter, for a calculus; this is especially apt to happen in children. In these cases, however, the mistake may usually be guarded against by the absence of a distinct click, though a rough grating sensation be experienced, and by the surgeon being unable to isolate a stone. Yet the difficulty in some cases is great; Velpeau states that he is acquainted with four instances, and S. Cooper with

seven, in which patients have been cut and no calculus found; and when we reflect that these accidents have happened to such men as Cheselden, who on three occasions cut a patient and found no stone; to Crosse, to Roux, and to Dupuytren, it is easy to understand that in some cases the difficulty of coming to a correct decision must be very great.

In women the symptoms of stone closely resemble those met with in men, and the detection of the calculus is usually very easy, owing to the shortness of the canal and the facility with which the stone may be tilted up by introducing the fingers of the left hand into the vagina. The sound used in these cases should be shorter and less curved than that employed for the detection of calculus in the male bladder.

After a stone has existed for some time in the bladder it induces serious pathological changes in the whole of the urinary apparatus. The urethra usually becomes slightly dilated, and the prostate not unfrequently somewhat enlarged and irritable, in consequence of which a kind of pouch is formed behind it, in which the calculus is apt to lodge. The most important changes, however, take place in the bladder and kidneys. The bladder becomes extremely sensitive, especially about its neck, and is consequently unable to contain as much urine as usual; hence it becomes contracted. In some rare instances, however, as will be more especially noticed when we come to speak of lithotrity, it falls into an atonic condition, and then is apt to become rather largely dilated. The mucous membrane is commonly a good deal inflamed and irritated by the presence of the calculus, and the muscular coat becomes thickened and hypertrophied, so as to give it a very fasciculated or columnated appearance. Cysts occasionally form containing sabulous matter and fetid pus or urine, and in some cases lodging a concretion, which then constitutes an encysted calculus lying altogether outside the cavity of the bladder, with which it merely communicates by a very narrow aperture, as in figs. 358 and 359, representing a case that was under my care some years ago, and which is fully described in the Journals for March, 1853. The kidneys are usually irritated, often congested, frequently in a state of granular degeneration, and ultimately become the seat of such structural changes as are incompatible with life. When death occurs as the consequence of stone, the patient usually sinks, worn out by protracted suffering and kidney disease.

OPERATIONS FOR THE REMOVAL OF STONE FROM THE BLADDER.

Calculus may be removed from the bladder by two distinct operations. By *lithotomy*, or the cutting operation; and *lithotrity*, or the crushing one. We shall first consider lithotomy, as the more ancient, and perhaps even yet the more common, operation of the two.

It is not my intention to enter into the general history of lithotomy—an operation that has been practised from the earliest ages; and a sketch of the gradual modifications of which, that have at various times been introduced, from the rude attempts of the Greek and Roman surgeons to the barbarous and unscientific procedures adopted by the itinerant operators after the revival of letters, would occupy much space and be attended by but little advantage. For all this I would refer the reader to the classical works of Deschamps and of John Bell. The operation, as now generally practised in this country, is essentially that introduced by Cheselden, and modified more or less according to the peculiar views of particular surgeons. Hence there are a variety of ways in which it is performed, though surgeons generally are agreed upon the great principles involved in it. It is in carrying these out that they differ — as in the direction and extent of the incisions, and in the instruments employed, which have been much varied to suit the taste of particular operators. This detail would be foreign to this scope of the work: I shall, therefore, in a great

measure confine myself to the description of that particular modification of Cheselden's, or the lateral operation introduced by the late Mr. Liston, most skilfully practised by him, and now very generally adopted by most of the best surgeons of the day in this country.

Before subjecting a patient to operation, his general health must be properly attended to; and, indeed, if we find the constitution much broken by prolonged suffering, the bladder or kidneys seriously diseased, as indicated by the existence of pus or albumen in his urine in large quantity, it will be wise to postpone the operation for a time, or perhaps even to defer it altogether. Supposing, however, that the stone is of moderate size, that the patient's health is in a pretty good state, that the urine is either healthy or contains but a moderate quantity of pus or albumen, and that there is no visceral complication to prevent the performance of the operation, it will only be necessary to subject him to proper preparative treatment for a short time, so as to allay or remove irritability of the urinary organs, before proceeding with it. With this view, he should be kept as quiet as possible for about a week or ten days preceding the operation; his diet should be properly regulated, but not be of too low a kind; pain lessened by the administration of opiates or henbane, and the bowels properly relieved. On the day preceding the operation, a dose of castor-oil or some other aperient should be administered; and, on the morning of the operation, the rectum must be emptied by means of an enema.

LATERAL OPERATION OF LITHOTOMY.

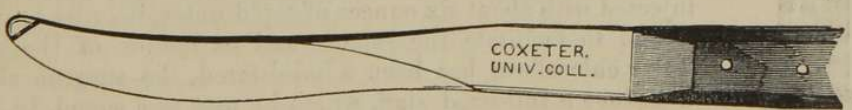
The surgeon must see that the table is firm and of a convenient height, so that, when he sits on rather a low stool, the patient's nates will be on a level with his breast; a few blankets doubled should be laid upon the table, covered by a piece of tarpaulin hanging over the end, and a tray of sand placed under it on the floor. The instruments necessary are the following: a pair of lithotomy tapes, a sharp and a probe-pointed scalpel, a staff, forceps, and scoops of various sizes, and a tube. To these may be added a searcher, and a brass injecting syringe.

The tapes should be of coarse flannel, about three yards long, by three inches broad.

The scalpel for the adult may be of the size and the shape represented (fig. 364); for children it may be made proportionately small. A probe-pointed

Fig. 364.

Fig. 365.



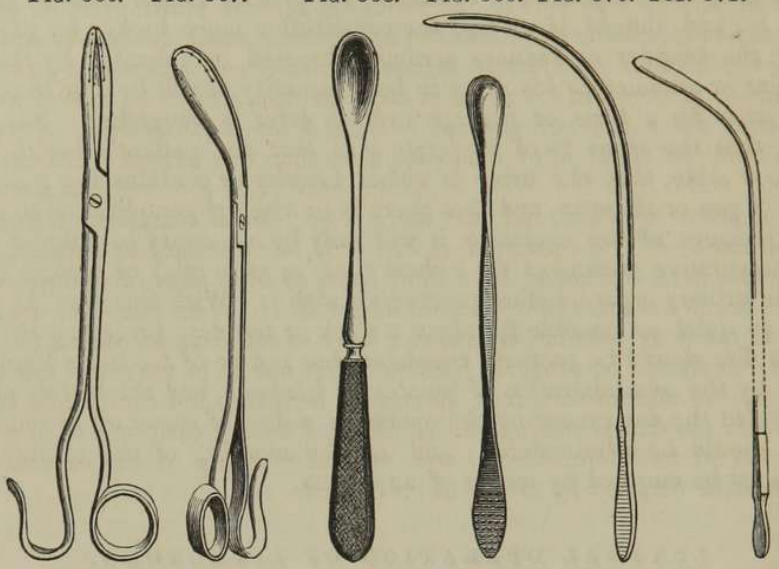
lithotomy-knife should also be at hand, of the size and shape here represented (fig. 365).

The staff should have a deep groove on its left side, occupying nearly one-third of the instrument; it should be well curved, of as large a size as the urethra will admit, and have a roughened handle (fig. 370).

The forceps must not be too heavy, but should be of a good length in the handles, and have the joint well set back; the inside of the blades, as recom-

mended by Mr. Liston, should be lined with linen, to prevent the stone slipping (fig. 366). Mr. Coxeter has lately made them with open blades, but lined with linen as heretofore (fig. 372); in this way, as there is less metal, the weight is

Fig. 366. Fig. 367. Fig. 368. Fig. 369. Fig. 370. Fig. 371.



diminished, and the diameter of the instrument with a stone in its grasp is materially lessened. The ordinary forceps are straight, but it is advantageous to be provided with some that are curved (fig. 367). The handles should be made with a loop on one side and a ring on the other; the ring for the reception of the thumb should be placed somewhat obliquely. The scoops of different sizes, and curved, can most conveniently be used when fixed in a roughened handle (figs. 368 and 369). The tube should be of gum-elastic, well rounded at the end, and provided with silver rings. The searcher is a slightly curved sound having a bulbous extremity (fig. 371). The syringe presents nothing peculiar.

Fig. 372.

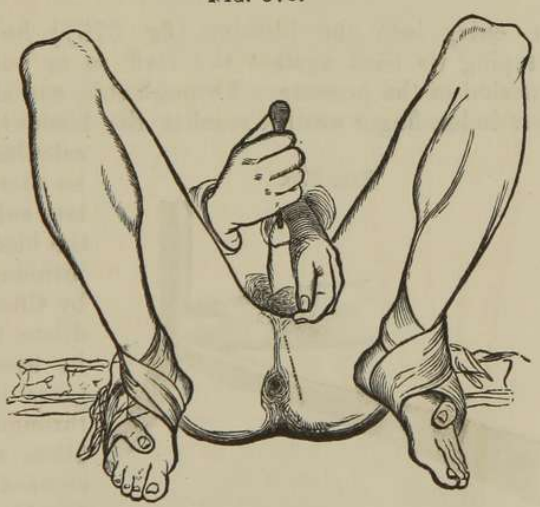
In describing the operation of lithotomy, we shall first of all consider the different steps *seriatim* of an operation that presents no unusual complication or difficulty; we shall then consider the difficulties that may be met with during the operation, the accidents that may occur, the principal sources of danger, and the causes of death.

Ordinary lateral operation.—The patient should be desired to hold his water for two or three hours before the operation, but if he has not done so, and the bladder is empty, it must be injected with about six ounces of tepid water, in order to steady it and to facilitate the seizure and extraction of the stone. After chloroform has been administered, the surgeon should introduce a full-sized staff, which he uses as a sound, in order to feel for the calculus If he detects it, he proceeds with the operation; if he cannot detect it, it is usually recommended that he should withdraw the staff and introduce a sound, with which he examines the bladder, and in the event of his still failing to discover its presence, the operation must be deferred, for it is an imperative rule in surgery that lithotomy should never be performed unless the stone can be felt at the time that the patient is actually on the table. It is, however, safer not to proceed with the operation unless the stone can be

felt with the staff, lest the point of this, though apparently in the bladder, be actually engaged in a false passage. The patient is then to be firmly tied up and brought to the end of the table, so that his nates project beyond it, where he is to be securely held by an assistant on either side, who grasps the foot in his hand, places the patient's knee under his arm, and draws the limbs well aside, so that the perineum may be fairly exposed. It is desirable that the perineum be thus fully exposed to the surgeon. In a patient, however, on whom I once operated, this could not be done, owing to the left hip being stiffened by chronic rheumatic arthritis; but I did not experience any particular difficulty in the operation, though somewhat inconvenienced by the position of the limb. The surgeon then seating himself before the patient, shaves the perineum — if this have not already been done — and introduces his finger into the rectum to see that the gut is empty. He then gives the staff in charge of a trusty assistant, who stands on the patient's left, and who raises and draws aside the scrotum with the left hand whilst he holds the staff in the right (fig. 373). The surgeon then sees that the staff is held in the way in which he prefers it. There are two ways in which it may be held; it may either be drawn well up into the arch of the pubes, or it may be pushed somewhat down, and slightly turned towards the left of the perineum. Liston always employed the first method, which I certainly think is the best, as it tends to increase the space between the urethra and the rectum, and consequently lessens the danger of wounding that gut, which more than counterbalances the advantage of the other method — that of approaching the membranous portion of the urethra to the surface.

The external incision is made by entering the knife in the raphe of the perineum one inch and a half above the anus, and carrying it downwards and outwards until it reaches a point that is just below the anus, but about one-third nearer to the tuberosity of the ischium than to the margin of the anal aperture (fig. 373). It is useless to prolong the incision beyond this, as any freer division of the structures of the scrotum and on the nates cannot facilitate the extraction of the stone; but it must occupy the extent indicated, otherwise considerable difficulty may be experienced in the later steps of the operation. The depth to which this incision should be carried must vary according to the obesity of the subject, usually from about three-quarters of an inch to an inch.

Fig. 373.

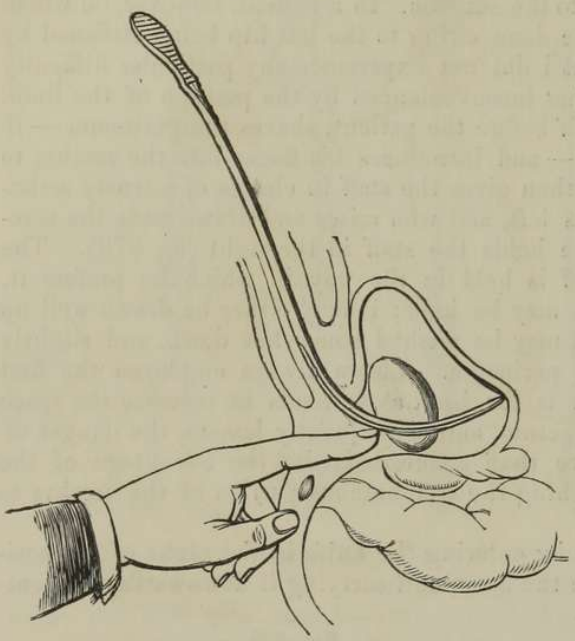


By this incision the skin, superficial fascia, and subcutaneous fat are divided. After it is completed, the knife is introduced again towards the upper part of the wound, and the blade run lightly downwards over any resisting structures, the left fore-finger being placed at the middle of the wound so as to protect the rectum. In this way the transversalis perinei muscle is divided together with some cellular tissue and small vessels, and the triangular space is opened between the accelerator urinæ and erector penis muscles; the knife is then withdrawn, and the left index finger pushed deeply into this space until the edge of the nail is lodged in the groove of the staff (fig. 374), which can be felt just anterior to the prostate, thinly covered by the membranous portion of the urethra. The point of the knife is then

pushed through the urethra at its membranous part into the groove of the staff, above the index finger, which protects and presses to the right, the rectum lying beneath it (fig. 375).

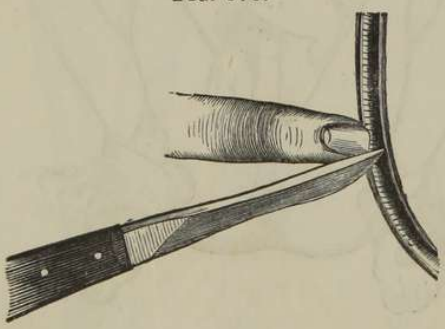
When the knife is felt to be well lodged in the groove, its handle is slightly depressed so that the point may be raised, at the same time the blade should be somewhat lateralized, so that its side lies parallel to the ramus of the ischium. If the edge is turned too directly downwards towards the mesial line the rectum may be wounded, and if directed too much outwards the internal pudic artery will be endangered (fig. 377); hence the mid course is the proper one.

Fig. 374.



The surgeon keeping the knife steadily in this position and pressing the point firmly against the side of the groove of the staff, which he must never for a moment lose, pushes it forwards through the deep perineal fascia, a few fibres of the levator ani, and the prostate, and thus makes an entry into the bladder (fig. 376); he then withdraws the knife by keeping its back against the staff so as not to enlarge the extent of the incision in the prostate. Through this, and along the staff, he then pushes his left index finger until it reaches the bladder, when he endeavors to feel the calculus with its tip. Should his finger be short, the perineum deep, or the prostate enlarged, he may be unable to reach the bladder in this way; and must then introduce a blunt gorget, as recommended by Cheselden and Martineau, in order to dilate the aperture in the prostate. If he uses his finger for this purpose, he gives it a twist or two after passing it through the prostate so as to expand and dilate the aperture through which it is entered. Having made sure that it is in the bladder, and having felt the stone, he directs the assistant to withdraw the staff from the urethra.

Fig. 375.

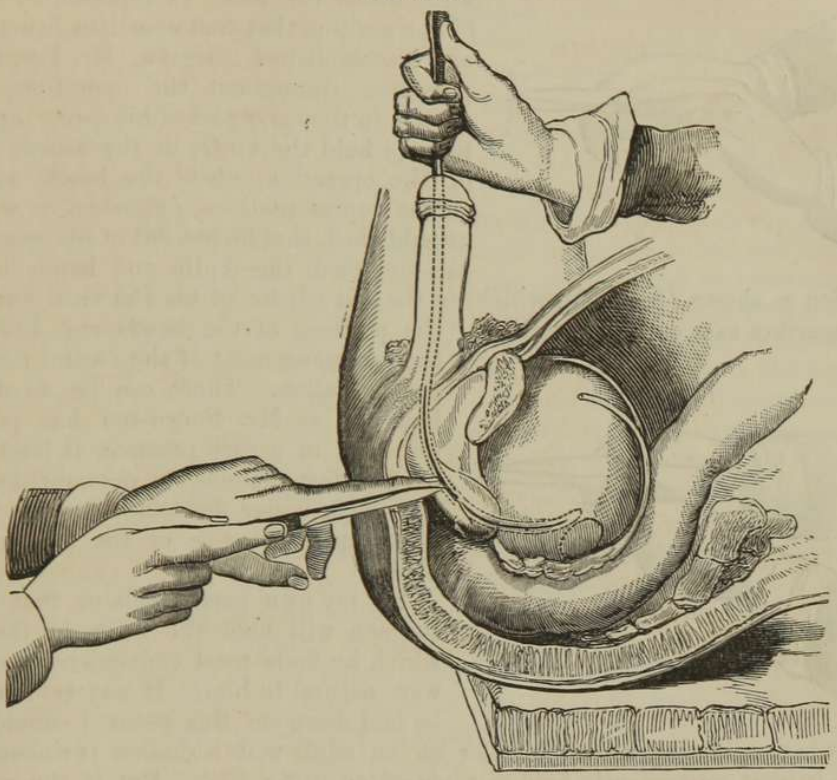


Here let us pause and examine the principal points in this the first and second stages of the operation. It will be observed, that in accordance with the best authorities upon the subject, and with my own experience, I have recommended the external incision to be free, the rectum to be protected by the left index finger, and the knife to be somewhat lateralized during and after the opening of the urethra.

1st. The position of the knife must be carefully attended to, especially during the deep or second incision. At this stage of the operation the edge should be *lateralized*, that is, directed about midway between the horizontal and perpen-

dicular position, so that the surface of the blade lies nearly parallel to the ramus of the ischium. The manner of holding the knife has been much discussed,

Fig. 376.



and necessarily and naturally varies with different surgeons. I believe it signifies little how the handle of the instrument is held between the surgeon's

Fig. 377.

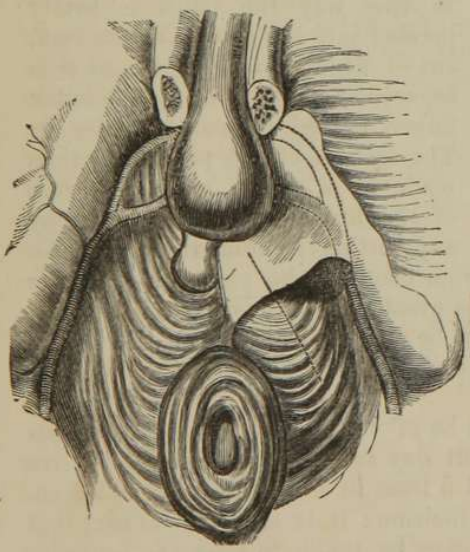
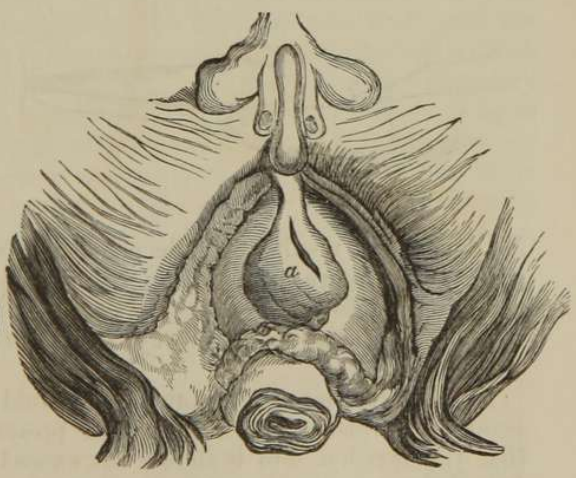


Fig. 378.

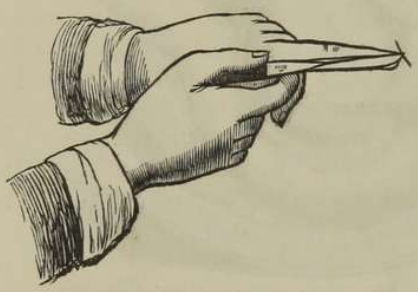


fingers, provided the edge is never turned upwards, but is always kept well lateralized, and the point steadily pressed into the groove of the staff.

Provided a surgeon knows what he is about, he may safely hold his knife as best suits his own convenience. In the first incision, most operators, I believe, hold the knife *under* the hand, as represented in fig. 379, a position that that excellent lithotomist and accomplished surgeon, Mr. Fergusson, preserves throughout the operation. Mr. Liston, in the early part of his career, appears to have held the knife, in the second stage of the operation, *above* the hand; and in all the representations, published as well as unpublished, that he has left of his operation, has depicted the knife and hands in the position as shown (fig. 380), which, in the last edition of his Practical Surgery, he describes as a correct sketch of "the position of the hands and knife" at the commencement of the second stage of the operation. There can be no doubt, however, as Mr. Fergusson has pointed out, that in actual practice, at least after his first few years as an operator, he held the knife under the hand with the index finger upon the side or the back of the blade.

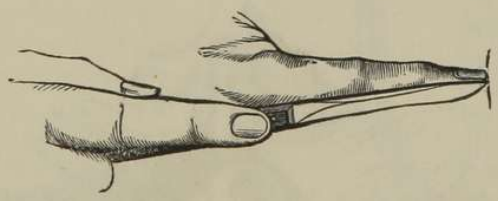
Fig. 379.

Fig. 380.



For my own part, I believe that every surgeon will hold the knife in the way which he finds most convenient, and as it were natural to him. If any rules are to be laid down on this point, I should say, that when operating on a child, or on an adult with a shallow perineum, the knife is most conveniently held as represented in fig. 379. But if the patient be fat and the perineum deep, then I think that it is a question whether greater steadiness may not sometimes be secured by holding the knife somewhat in the manner of a gorget, with the index finger, perhaps, a little more upon the side of the handle (figs. 376 and 381); in this way the point is firmly pressed into the groove of the staff, out of which it cannot slip, as it is secured and supported by the index finger being somewhat under it. The section of the prostate is thus made by a steady push or thrust of the knife forwards, and not by any cutting movement downwards. No danger can result in the deep incision from pushing the point of the knife up into the groove of the staff; but there is great risk of missing the bladder, and getting into the recto-vesical space, if it be at all depressed and the handle raised, though this cannot always be avoided if the staff be pushed deeply into the bladder.

Fig. 381.



2d. The incision into the prostate should be of very limited extent: on this point all surgeons, I believe, of the present day are agreed. Scarpa advises that the incision into it should not exceed 5 lines in adults and 2 in children. It is difficult to measure the extent of the incision: it is sufficient to say, that it should be as limited as possible; and if care be taken to push the knife in, with the point well pressed against the groove, and the blade forming but a limited angle with the shaft of the staff, and especially in withdrawing it that it be brought carefully back over the finger and still in contact with the instru-

ment, there will be no danger in cutting too widely, or in doing more than merely notching the apex of the prostate (fig. 378, *a*). The danger, however, it must be borne in mind, does not consist in the section of the gland itself, — which is in reality a structure of but little importance,—but in cutting beyond it into the reflections of the pelvic fasciæ, which will be opened up if the base of the prostate be cut, and the wound of which will, almost to a certainty, be followed by urinary infiltration and diffuse inflammation.

In the section of the prostate then, two points have specially to be attended to: one is, that the knife in entering be not pushed forwards at too great an angle with the staff, so as to cut widely; and the other is, that in its withdrawal the blade be kept steadily in contact with the staff; indeed, I believe there is more danger of doing mischief in the withdrawal than in the entry of the knife, for if it leave the staff for a moment all guide is lost and the edge may sweep downwards through the base of the prostate and its investing capsule. As the knife is withdrawn, the left index finger is pushed forwards into the aperture in the prostate, which is then dilated by its pressure to a sufficient extent for the introduction of the forceps, which are slipped in as the finger is withdrawn, and the extraction of the stone. This part of the operation may very conveniently be performed, as was usually done by Mr. Liston, at the moment the surgeon is stooping down, engaged in selecting his forceps. It is readily effected; for the prostate, though dense, is friable, and breaks down easily under somewhat forcible pressure by the finger. In this way, by a mere notching of the prostate, — by a slight section of its apex or urethral surface, followed by simple dilatation with the finger, — sufficient space will be obtained for the extraction of all moderate-sized calculi, without the employment of any violence, or the infliction of any bruising upon the tissues.

[In the performance of the lateral operation for lithotomy Dr. Pancoast, of Philadelphia, has for many years been in the habit of dividing the prostate gland and neck of the bladder by a manœuvre of a different character from that described in the text. The staff employed by Dr. Pancoast in his operation, is one of considerable curve, and is held by an assistant so that the convexity of the instrument shall bulge somewhat forward in the perineum. The knife which he prefers is an ordinary scalpel slightly concave on the back. This is made to reach the groove by the usual incision, and the blade being lateralized, is held like a gorget, with its point in the groove of the staff.

The operator then takes the handle of the staff in his left hand, and as he brings it down, carries by the same motion the blade of the knife and the curved portion of the staff upwards in the direction of the longitudinal axis of the bladder. The edge of the knife in its transit will thus effect the necessary division of the prostate gland. The peculiarity of this manœuvre depends upon the fact, that the position of the knife with regard to the staff, is not changed during the execution of the process just described. The point of the blade held fixed in position enters the cavity of the bladder synchronously with the curve of the staff against which it rests; and it is not thrust forwards along the groove of the latter, according to the usual custom.

The advantages possessed by this procedure are, in the estimation of Dr. Pancoast, the facility and quickness with which it is performed; the diminished risk of injury to the rectum, and the comparatively limited division of the prostate gland. In consequence also of the upward movement of the knife, an absolute degree of immunity is afforded to the base of the bladder, so frequently wounded by the horizontal thrust of the instrument through the prostate gland, which, it must be remembered, is often depressed by the staff, nearly to the level of the lower fundus.

In the opinion of Dr. Pancoast there is also much less risk of hemorrhage, as the circular movement of the knife divides to a less extent, the vascular and

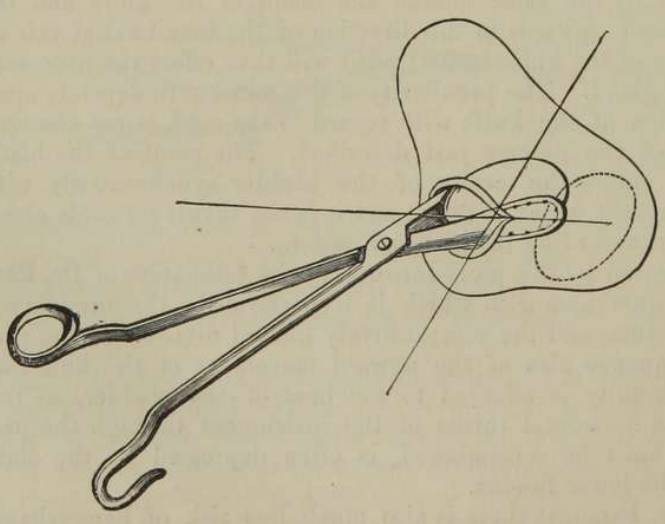
dilatable parts anterior to the prostate, for the protection of which the angular knife of Blizard was devised.]

But another obstacle exists which will prevent the dilatation of the neck of the bladder to any very material extent, without an amount of bruising, or laceration, or even rupture that would probably prove fatal to the patient. This obstacle consists of a tissue, which has been described by Mr. Tyrrell as "an elastic ring" surrounding the neck of the bladder; by Mr. Liston, as "a fibrous or ligamentous band surrounding the orifice of the bladder, into which the muscular fibres of the organ are inserted." If this band be ruptured, either by the finger or by the expansion of the forceps, fatal consequences will ensue; but if it be divided, the other tissues, as Mr. Liston observes, will yield to an inconceivable extent, without injury to the ilio-vesical fascia.

In thus describing the mode of incising the prostate and neck of the bladder, I have, generally, used the term "dilatation;" and I believe, that by a simple process of dilatation or expansion of these parts, and without any violence whatever, small calculi of or under an inch in diameter may be extracted. In fact, for the removal of such stones, no force whatever is required, either in opening up the prostate or in withdrawing the calculus. But in removing stones of greater magnitude than this, I believe that the process of expansion of the prostate and neck of the bladder, whether effected by the finger, a blunt gorget, or the opening up of the blades of the forceps, is a process of laceration rather than of dilatation, as I have frequently had occasion to observe in experiments on this point made on the dead subject. This laceration is, however, confined to the substance of the prostate, and does not extend through its capsule, or into the fasciæ of the pelvis, without the employment of an extreme degree of violence, which would probably prove fatal.

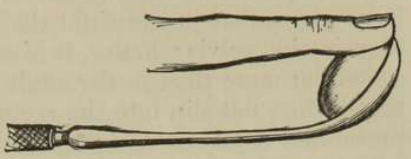
3d. The next stage of the operation consists in the extraction of the stone. A pair of forceps of sufficient length and size, proportioned to that of the calculus, and previously warmed by immersion in tepid water, must be slid along the index finger, which is kept in the wound, and by which the neck of the bladder should be drawn somewhat down so as to meet the instrument. In this way, also, the stone may often be fixed by the point of the finger, and its position thus accurately determined. The forceps having been introduced closed, the finger is withdrawn, when a gush of urine will usually take place through the wound, if that fluid have not already escaped at the time that the incision is made through the prostate. By this gush the calculus may, as Mr. Fergusson observes, sometimes be carried into the grasp of the instrument; most commonly, however, the stone requires to be felt for with the closed forceps. When its position has been ascertained, usually at the inferior fundus, the blades are opened, and by pushing one against the wall of the bladder and giving it a slight shake, the calculus generally drops between them, though occasionally it is somewhat troublesome to seize, and this indeed often constitutes the most tedious and annoying part of

Fig. 382.



the operation. The forceps having the stone in their grasp are then closed and the stone drawn downwards through the wound. If it be small, it may be extracted at once without any difficulty; if of moderate size, the finger should be introduced along the blades, in order to feel whether it is in a proper position for extraction. If its long axis lie across the wound, this must be changed, and it must then be withdrawn by a kind of to and fro movement in the direction of the axis of the pelvis (fig. 382). Should the stone be broken, or should there be several small calculi, they may generally be best removed by means of the scoop (fig. 383). In the event of fracture occurring, it would be necessary to wash out the bladder with tepid water, injected by means of a brass syringe, through a tube introduced by the wound.

Fig. 383.



In children, and indeed in most cases in which the perineum is not very deep, so that after the introduction of the finger the stone can be felt and hooked forwards, the scoop is a most convenient instrument for its extraction, and in these cases I usually employ it in preference to the forceps.

After the calculus has been removed it must be examined for facets, or the interior of the bladder explored by means of a searcher; and if other stones be found they must be dealt with in the same way as the first.

The gum-elastic tube may then be introduced, and secured with tapes to a band round the patient's abdomen. This tube must be kept free from coagula by the introduction into it, from time to time, of the feather of a pen. By means of this tube a ready outlet is given to the urine, and the chance of infiltration is lessened.

The patient must then be removed to a bed, which should be properly arranged by having a large square of Macintosh cloth put across it. On this a folded sheet should be laid, which must be rolled up on the further side so that as it becomes wetted by the escape of urine, it may be drawn across from under the patient. This must be changed frequently in order to keep him clean and dry. A full dose of tincture of opium in barley water should then be given; a warm flannel laid across the abdomen; plenty of barley or gum water allowed for drink, and nothing but rice-milk or light pudding for diet during the first three or four days. After this some broth may be allowed, and the quality of the food gradually increased. Occasionally, however, it may be necessary to depart from this rule. I have, indeed, on several occasions found it necessary to depart from the routine system of dieting the patient after lithotomy, and have with great advantage allowed wine, and even brandy, a day or two after the operation. In an old man, on whom I recently operated at the hospital, there was so great a tendency to depression, that it became necessary to administer the brandy-and-egg mixture freely from the first, and to this I believe he owed his good recovery.

At the end of thirty-six or forty-eight hours the tube may be removed, the sides of the incision by that time having become glazed over, and little danger of infiltration existing. The water continues to flow entirely through the wound for the first four or five days. About this time it frequently suddenly ceases to do so, escaping by the urethra. This is owing to the prostate becoming turgid by inflammatory action, and thus blocking up the aperture in it; but as this swelling goes down, in the course of a day or two, the urine usually escapes by the wound again, and continues to do so in gradually decreasing quantities until the aperture is finally closed, which usually happens at about the end of fourteen or eighteen days; though in patients who suffer from phosphatic calculus it sometimes takes a longer period, owing to the broken state of the general health. After the operation appropriate constitutional

treatment should be continued for some time in order to prevent a recurrence of the disease.

Lithotomy in children is performed much in the same way as in the male adult; though it is worthy of note that the urethra will commonly be found larger than might be expected from the age of the child, readily admitting a No. 8 or 9 staff. The perineum also is usually proportionately more vascular in consequence of the irritation and straining. The most important point, however, is, that in the child the bladder lies high, being rather in the abdomen than in the pelvis; hence, it is of importance to raise the point of the knife somewhat more than in the adult in making the deep incision, and to be careful that it does not slip into the recto-vesical space, which may happen unless this precaution is taken. I have known this occur in several instances to hospital surgeons; the forceps being passed into this space under the supposition of its being the bladder, and in every case the patient died unrelieved. This accident is the more likely to happen, because in children the parts are very yielding, and readily admit of being pushed before the knife or finger, and the finger may thus pass between the neck of the bladder and the pubes, or into the loose cellular tissue of the recto-vesical space. The urethra being opened urine escapes, and the surgeon gets his finger into a distinct cavity, which he believes to be the interior of the bladder, but which is not so, but the recto-vesical space.

DIFFICULTIES DURING AND DANGERS AFTER LITHOTOMY.

The *difficulties* during the operation are two-fold; — getting into the bladder, and extracting the calculus.

The *difficulty of getting into the bladder* is rarely experienced. It may, however, arise in consequence of the surgeon neglecting to keep the point of the knife well lodged in the groove of the staff, and thus letting it slip into the recto-vesical space, the tissue of which being broken up, leaves a kind of cavity that he mistakes for the interior of the bladder. If the perineum is very deep and the prostate enlarged, he may also experience some difficulty in reaching the bladder, but he can scarcely fail to do so if he push the knife well on in the groove of the staff, and dilate the incision in the prostate with a blunt gorget, if his finger fail to reach the cavity beyond it.

If, after the groove in the staff has been exposed, care is not taken to insinuate, as it were, the nail into the opening in the urethra thus made, the membranous portion may be torn across, and the neck of the bladder may easily be pushed away from the surface, receding before the finger, the surgeon failing in reaching its cavity. When the road is once lost in this way, there is the very greatest difficulty in finding it again. The course that should be pursued is, I think, as follows: If the staff has not been withdrawn, the surgeon must again place the knife in its groove, and carefully push it on towards the neck of the bladder, notching that structure and passing the finger cautiously along the groove, and hooking down, as it were, the parts with his nail until he reach the inside of the bladder. Should the staff have been withdrawn, the surgeon must endeavor to pass it again; if he succeed in this, he may act as just stated; but if he cannot succeed in introducing the staff fairly into the bladder, he must, on *no account whatever*, endeavor to open that viscus, or continue his attempts at the extraction of the calculus, but should at once abandon the operation until the parts have healed, and then repeat it. The great danger in these cases arises from the surgeon losing his presence of mind, and endeavoring to enter the bladder without a guide, a procedure that must be unsuccessful, and can only end in the destruction of the patient.

In adults, the difficulty is to get out the stone; in children, to get into the bladder.

Difficulty in seizing the stone not unfrequently occurs. This is likely to

happen in all those cases in which, whether from the depth at which the bladder is from the surface, or the peculiar position of the calculus, the stone cannot be felt with the finger after the incisions have been made into the neck of the bladder. This is especially apt to happen if the patient is old and fat, and has a deep perineum, with perhaps some enlargement of the prostate, which constitutes the greatest difficulty in this respect, the calculus resting behind it in the deep fundus of the bladder. In such cases as these, long and curved forceps should be used. So, also, if the stone is very round, it is usually more difficult to seize than when flat or elongated. Flat, disc-shaped calculi, however, occasionally fall into the fundus of the bladder behind the prostate, and then cannot be readily reached by the forceps, which pass over them. Under these circumstances they are best extracted by the curved scoop.

Difficulty in extracting the calculus is far more frequently met with than in reaching the bladder. This may be owing to a variety of causes. The position of the stone may be such that it can scarcely be reached with the forceps; thus, when it is situated in the upper fundus of the bladder above the pubes, it is altogether out of the axis of the incision, and in such a case can only be extracted with great difficulty. Key recommends that in such cases the abdomen should be compressed, and thus the calculus pushed down into reach. This suggestion is a very useful one; and it was only by employing this manœuvre, and using a very curved scoop, that I could remove a calculus lodged above the pubes, in a patient whom I cut at the hospital some years ago.

The calculus may be lodged in the lower fundus, behind an enlarged prostate. Here the best plan is to use a much-curved pair of forceps, and to tilt the bladder up by introducing the finger into the rectum, and thus bringing the stone within reach.

Difficulty in extraction may occur in consequence of the stone being in some way fixed to, or retained in the bladder; thus, a small calculus may be enveloped by the folds of the mucous membrane, and in this way elude the grasp of the forceps. Under these circumstances, there is nothing for the surgeon to do but patiently to try to disentangle and remove the calculus by means of the finger and scoop, if it can be so reached; if not, by expanding the forceps in the bladder, to try to push aside the mucous membrane that surrounds it.

In consequence of spasm of the bladder, it has occasionally happened that a calculus is so firmly fixed as not to admit of the application of the forceps, the blades of which cannot be introduced between the walls of the viscus without using an improper degree of force, and giving rise to the danger of rupturing the neck of the bladder. Under these circumstances, I think it would be safer for the surgeon to desist from the operation, and in the course of a few hours or the following day, when the spasm might possibly be relaxed, complete the extraction, and thus perform the operation "*à deux temps*" of Deschamps.

The stone may be so fixed between hypertrophied fasciculi in the interior of the bladder, as to be detached with considerable difficulty. In such cases as these the scoop will be found to be the most useful instrument. When the calculus is encysted, its extraction will probably be impracticable, or attended with the most dangerous consequences. Hence, it is expedient not to operate in cases of encysted calculus that are known to be such. If, however, the surgeon has been unfortunate enough to cut into a bladder containing an encysted calculus, he must be guided in the course he should adopt by the condition in which he finds the stone. If the aperture leading into the cyst be very small, as in fig. 359, the better plan will be to proceed no further with the operation, as it would be clearly impossible to remove the stone. If, on the other hand, the aperture into the cyst be large, he might feel disposed to make an effort to extract the calculus. With this view he might adopt the plan pursued by Sir B. Brodie in such a case, and endeavor to enlarge the orifice of the cyst by means of a probe-pointed bistoury cautiously applied, and then finish the ex-

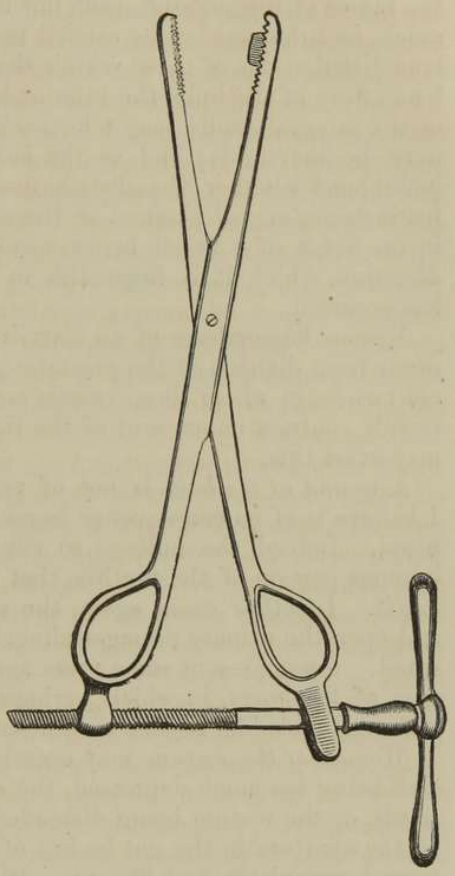
traction by means of a scoop. Such a proceeding, however, is in the highest degree hazardous, on account of the readiness with which the section might extend into the peritoneal cavity; as well as difficult in execution, from the depth at which the parts are lying. I believe that a calculus may occasionally be encysted, or rather encapsuled, in another way, — by being covered in by a kind of false membrane whilst lying on the floor of the bladder. This condition I found in a child that I cut for stone some years ago. After removing a calculus about the size of a pea, I felt, with the end of the finger, a hard, irregular body, covered apparently by mucous membrane, lying at the inferior fundus of the bladder. On scraping through the membrane covering this with the point of the nail and a curved scoop, I exposed the calculus (fig. 357), and removed it, with a cyst attached to it. On examining the structure of this cyst, which was about the thickness of ordinary writing-paper, of a reddish color, and resembling a piece of mucous membrane, it was found to be a false membrane, composed of organized fibro-cellular tissue. The patient made a good recovery, with the exception of a slight attack of secondary hemorrhage which occurred on the eighth day after the operation.

The principal difficulty in extracting a calculus generally depends upon the shape and size of the stone. Very flat, broad calculi, those that are round, egg-shaped, or branched, are the most difficult to remove, even though their size be not very great. As a general rule, however, it may be stated that the larger the calculus, the more difficult is its extraction. This arises not so much from the outlet of the pelvis being too narrow, but from the necessity of making the internal incisions through the prostate to a very limited extent. There will always be considerable difficulty experienced in extracting calculi weighing six or eight ounces and upwards, though cases are recorded by Cheselden, Klein, and others, in which calculi from twelve to fifteen ounces in weight have been extracted by the lateral operation. Any calculus above one-inch and a quarter in its shorter diameter will present considerable difficulties in being extracted through an incision in the prostate of the ordinary size; viz., about eight lines in length, even though this be considerably dilated by the pressure of the fingers; and, I think it may be safely said, that a calculus two inches and upwards in diameter, can scarcely be removed by the ordinary lateral operation with any degree of force that it is safe to employ. In the facility with which the calculus is extracted, however, much will depend upon the make of the forceps. As Liston most truly observes, "There can be no more fatal error than to attempt the extraction of a large stone with short and shabby forceps." In these cases, I think the open-bladed forceps (fig. 372) will be found useful, the absence of metal in the most convex part of the blade lessening materially their diameter when grasping a stone.

In the event of the calculus being too large to be extracted by the ordinary lateral operation, what course should the surgeon pursue? Three are open to him: 1st. The division of the right side of the prostate from the interior of the wound. 2d. Crushing the calculus in the bladder, and then removing it; and 3d. The performance of the high or supra-pubic operation. The incision of the right side of the prostate gives considerable additional space, and is sufficient for most ordinary purposes; very large calculi being fortunately very rarely met with. This section may be made by introducing a probe-pointed scalpel (fig. 365) into the wound, guided by the index finger, and cautiously dividing the right side of the prostate downwards and outwards, in the same way that the section of the left has been made. This procedure must be carefully done, with due regard to the important parts in the neighborhood of the gland. In two cases I have seen Mr. Liston do this. In one the patient recovered, in the other he died of diffuse cellular inflammation of the pelvis; and I had occasion recently to practise it on a patient whom I cut at the hospital, and who made an excellent recovery. The second plan, that of crushing the calculus

in the bladder through the wound in the perineum, would certainly be a very hazardous procedure. The irritation that would necessarily be set up by the large lithotrite or crusher (fig. 384) that has been invented for this purpose, by the presence of the fragments of stone, and by the necessary difficulty and delay of clearing them out of the viscus, would probably be fatal to the patient. In the event of its being impossible to extract the calculus through the perineum, I think it would be safer to adopt the third course, and to perform the high operation, which will presently be described.

Fig. 384.



The principal accidents that may occur during the performance of the lateral operation of lithotomy are *hemorrhage; wound of the rectum; cutting the bulb,* or *missing the membranous portion of the urethra.*

Hemorrhage during lithotomy may occur from three sources: — 1st. The superficial arteries of the perineum; 2d, the deep arteries of this region; and, 3d, the prostatic veins. Hemorrhage from the division of the superficial or the transverse artery of the perineum is seldom of a very serious character, though occasionally if these vessels are of larger size than usual, they may furnish a serious quantity of blood; under such circumstances their ligature would be required, and might be practised either before or after the extraction of the calculus. It is better, if possible, to wait until the completion of the operation, lest the ligature be pulled off during the removal of the stone. The division of the deep arteries of the perineum, that of the bulb and the internal pudic, will be attended by far more serious and perhaps even fatal consequences; as, from the depth at which the vessels are seated; it would almost be impossible to apply a ligature to them unless the patient be very thin, and the perineum proportionately shallow. In the event of a ligature not being applicable, the surgeon would have to trust to plugging the wound around the tube, or to the pressure of an assistant's fingers continued for a considerable time. The pressure of the fingers of relays of assistants, kept up for a considerable length of time, is perhaps the surest mode of arresting the hemorrhage. The pressure must be kept up for many hours; thus South relates a case in which it was maintained for fourteen hours, and Brodie one in which, after twenty-four hours, it succeeded. The assistants should not be changed more frequently than necessary, each keeping up pressure for two or three hours, and removing his fingers as cautiously as possible. It is, doubtless, very rare for these arteries to be wounded when they follow their usual course, though such accidents have happened in the hands of some of the most skilful lithotomists, such as Home, Bell, Roux, and Desault. It was the opinion of the late Mr. Key that the artery of the bulb was generally cut during lithotomy, but in this I believe he was mistaken so far as its trunk is concerned, though doubtless in many cases the bulb itself may be wounded, and the mesh of twigs in which the vessel terminates divided; but this would not yield an alarming hemorrhage. The trunk of the artery of the bulb would,

however, be endangered by opening the urethra too high up, and lateralizing the knife too early, and might bleed very freely.

The internal pudic artery, bound down by a strong fascia and under cover of the ramus of the ischium, runs but little risk unless the knife be lateralized too much, and the incision be carried too far outwards. It is in some of the anomalous distributions of these vessels that the greatest danger would be occasioned. The artery of the bulb, the inferior hemorrhoidal, the dorsal artery of the penis, or the internal pudic may take such an anomalous course that their division must be inevitable; and as the surgeon has no possible means of knowing beforehand whether the distribution of the arteries is regular or not, and as his incisions are all planned on the supposition that they are, he is not to blame in the event of a vessel being accidentally divided when taking an abnormal direction, which it is impossible to be acquainted with until after the accident has occurred.

Venous hemorrhage of an alarming and even fatal extent has been known to occur from division of the prostatic plexus. This is especially apt to happen in old people, in whom these vessels not only become greatly enlarged, but do not readily contract on account of the rigidity of the neighboring parts. Plugging may avert this.

A *wound of the bulb* is not of very uncommon occurrence in lithotomy, and I believe is of no consequence beyond furnishing a small additional quantity of blood. Indeed, the bulb is so situated, in many cases overlapping the membranous portion of the urethra, that this can scarcely be opened without wounding it. In other cases, again, the surgeon may go into the opposite extreme, and open the urinary passages altogether beyond the membranous portion of the canal. I was present some years ago at the post-mortem examination of a fatal case of lithotomy, in which perhaps the most skilful operator of that day had opened the bladder beyond the prostate, leaving the urethra altogether untouched.

Wound of the rectum may occasionally occur either in consequence of the staff being too much depressed, the edge of the knife turned too directly downwards, or the rectum being distended and overlapping the sides of the prostate. If the aperture in the gut be but of moderate size, it will probably close as the wound granulates and fills up. If, however, the incision be more extensive there will be the risk of a recto-vesical fistula being induced; under such circumstances, treatment such as recommended for that disease should be adopted; or, perhaps it might be better at once to meet the difficulty by laying open the rectum through the sphincter into the wound.

SOURCES OF DANGER AND CAUSES OF DEATH AFTER LITHOTOMY.

Lithotomy, even in healthy subjects, is always a dangerous operation, and though the rate of mortality doubtless depends greatly upon the dexterity and skill of the operator, more is, I believe, due to the constitution and age of the patient. Sir B. Brodie most justly says, "Success in lithotomy most undoubtedly depends in a great degree on the manual skill of the surgeon, and on the mode in which the operation is performed; but it depends still more on the conditions of the patient with respect to his general health, especially on the existence or non-existence of organic disease." That the mere cutting into the bladder is not a very dangerous proceeding, provided that viscus and the kidneys are healthy, is evident from the fact that in those cases in which surgeons have had to extract bullets, bits of catheter, &c., from this organ, bad consequences have rarely occurred, though the operations have often been tedious; but in lithotomy the case is different, for here the bladder is not only usually in a state of chronic irritation, but the kidneys are frequently diseased, and these conditions influence more materially the result of these operations

than any other circumstances. Hence an operator may have a run of unsuccessful cases; or by a fortunate concurrence of favorable cases it has occasionally happened that a surgeon has cut 20 or 30 patients in succession without losing a single one; but several deaths then occurring, though the operation was performed in the same way and with the same care as before, his average falls to about the usual level. The late Mr. Lynn had cut 25 patients without losing one, and he said that he thought he had at last discovered the secret of performing lithotomy with success; but, he added, the Almighty punished him for his presumption, for he lost the next 4 cases that he cut. Mr. Liston, during a period of six years, in which he operated 24 times, lost no patient from lithotomy at University College Hospital; but out of the whole 37 cases which he cut during the period of his connection with that Institution there were 5 deaths; reducing the average to 1 in 7·2. This success was, however, very great when it is taken into consideration that most of these cases occurred in adults, and that many of them were of a very serious character. I find on reference to the Hospital Records, that only 7 of the patients were under 10 years of age, whilst 14 were above 50; of these, two were 80 years of age, of whom one died and the other recovered. I believe that Mr. Liston only lost one patient under 60 years of age, and that was a lad of 18 in whom he found it necessary to divide the right side of the prostate as well as the left, and who died of infiltration of urine. Thirty-eight patients, successively operated on at the Norwich infirmary, recovered; but the average rate of mortality in that Institution, calculated from 704 cases, has been 1 in 7¾. Cheselden only lost 1 in every 10¾; and according to Mr. South at St. Thomas's, the mortality has not amounted to more than 1 in 9¾; but a good many of these patients were probably children. Sir B. Brodie states, that of the 59 cases operated on in all the London Hospitals in the year 1854, 10 died; making the mortality as nearly as possible 1 in 6. According to Mr. Coulson the average mortality in England deduced from 1743 cases of the lateral operation is 1 in 6·93 cases; whilst in France it is 1 in 5·7; and for Europe generally 1 in 5·14.

Age exercises a marked influence on the result of lithotomy; which may be looked upon as one of the most successful operations in surgery at early periods of life, a hazardous one at middle age, and an extremely dangerous one at advanced age. At the Norwich Hospital lithotomy has been found to be four times as fatal in adults as in children. Mr. Coulson finds on analyzing 2972 cases of lithotomy that the mortality at each successive decennial period is as follows. Below 10 years it is 1 in 13, and thence gradually augments from 10 to 80 years to 1 in 9, 1 in 6, 1 in 5, 1 in 4, 1 in 3·65, 1 in 3·23, 1 in 2·71.

The shock of the operation occasionally proves fatal, though probably much less frequently so since the introduction of chloroform, than was formerly the case. Yet, even now, patients occasionally die from this cause, induced eithe by a very much prolonged operation, or by the system being weakened, and having lost its resisting power in consequence of disease of the kidneys, perhaps of a latent character. A prolonged operation, even under chloroform, is dangerous, and although it is certainly not well to operate against time, yet it is undoubtedly advantageous to finish the operation with as little delay as is consistent with the safety of the patient, even though he be anæsthetized.

Hemorrhage does not so often prove fatal, either shortly after the operation, or at a later period, as might be expected from the great vascularity of the parts incised. Secondary hemorrhage, of a dangerous or even fatal character, may, however, come on six, eight, or ten days after the operation. I have known it as late as the fourteenth day. It must be borne in mind, that when hemorrhage takes place after the operation, the blood may find its way into the bladder rather than escape externally, distending the viscus with coagula, but not giving any external evidence of the mischief that has occurred. Secondary hemorrhage will usually cease on plugging the wound with sponge or lint

soaked in alum solutions. Should it prove serious, however, the actual cautery may be advantageously employed. In a case that occurred to me on the ninth day, the bleeding was stopped by wiping out the wound with the actual cautery, a practice that Mr. A. Dalrymple informs me was occasionally successfully practised by that excellent lithotomist, his father.

Diffuse inflammation of the cellular tissue of the pelvis, especially of those layers around the neck of the bladder, between it and the rectum, and that extend from thence under the peritoneum, is the most frequent cause of death after lithotomy. This inflammation, which is always of the diffuse or erysipeloid kind, followed by rapid sloughing of the textures that it invades, may arise from two causes.

1st. From the urine getting infiltrated into the cellular tissue, in consequence of the incision extending beyond the limits of the prostate, into the loose layers of tissue that surround that gland.

2d. In consequence of the bruising and laceration to which the neck of the bladder, the prostate and the textures between it and the rectum are subjected, in prolonged attempts to extract a large calculus from the bladder.

The danger of cutting beyond the limits of the prostate has already been adverted to. In the extraction of calculi of ordinary size there can be no necessity to extend the internal incision; but when the calculus is of considerable magnitude, the surgeon, wishing to get as much space as possible, may inadvertently carry his knife beyond the prostate; or, if he make a cut into the right side of this gland, he may perhaps prolong it a little too far, and thus open the loose cellular tissue or fascia that surrounds it, and that is continuous with the pelvic and sub-peritoneal planes of cellular membrane. By dilating the incision in the prostate downwards and outwards, either with the finger or with a blunt gorget, the dense envelope surrounding the gland is not divided, and injury to this tissue is prevented.

If the incision extends beyond the prostate, the urine, as it escapes through the wound, sinks into the meshes of the loose cellular tissue over which it flows, and thus gives rise to infiltration, followed by rapidly extending inflammation and sloughing, which speedily involve the whole of the neighboring textures. This mischief generally occurs within the first forty-eight hours, and is indicated by the patient being seized with rigors, followed by dry heat of skin, a quick pulse, which, after a time, may become intermittent, and a dry and brown tongue. At the same time he will complain of some tenderness about the lower part of the abdomen, and in the groins; the belly becomes tympanitic, the body covered with a profuse sweat; hiccup comes on, the pulse becomes more weak and fluttering, and death usually occurs about the fourth or fifth day after the operation. In some cases there are more decided signs of peritoneal inflammation; but, as Brodie very truly remarks, this is not the primary disease, but is only induced secondarily by the inflammation and sloughing of the cellular tissue of the pelvis spreading to the contiguous serous membrane.

The *treatment* of such cases must be conducted on the ordinary principles that guide us in the management of diffuse inflammations. It is only by administering ammonia with such a quantity of wine or brandy as the state of the system may indicate, together with such nourishment as the patient can take, that life can be preserved. The disease is a depressing one, and requires a stimulating plan of treatment. Brodie has recommended that in these cases a free incision should be made through the sloughy tissues about the wound into the rectum, in accordance with the general principles that guide us in the management of similar affections elsewhere. In one case of the kind that occurred under his care, he saved the patient by passing a curved probe-pointed bistoury into the wound to its furthest extremity, to the left side of the neck of the bladder; he then pushed it through the tunics of the rectum, and, drawing it downwards, divided the lower part of the gut together with the sphincter; thus laying

the wound and the rectum into one. The relief was immediate, and the patient recovered. This plan of treatment certainly seems rational and worthy of trial in similar cases.

Diffuse inflammation of the cellular tissue around the neck of the bladder and prostate arising from bruising and over distension of the parts during the extraction of a large calculus is, I believe, a more frequent occurrence than infiltration of urine, and fully as fatal. This sequence of lithotomy is especially apt to occur in those cases in which, in consequence of diseased kidneys, or the existence of other organic mischief, the patient is more than usually liable to the supervention of diffuse or erysipeloid inflammation; indeed it is in this indirect way that I believe diseased kidneys constitute such a formidable obstacle to the safe performance of lithotomy.

In the extraction of large calculi, considerable traction is required and force must be exerted, hence undue bruising and pressure are very apt to be inflicted upon the parts that constitute the line of incision. It is in this way that the danger of lithotomy increases almost in exact proportion to the size of the calculus: for here the surgeon is often placed between the horns of a dilemma. He must either cut beyond the limits of the prostate and thus incur the risk of inducing urinary infiltration of, or diffuse inflammation in, the pelvic fasciæ; or else by limiting his incision to the margin of the gland, and thus having, perhaps, an aperture of insufficient size, inflict severe injury by the bruising and laceration of parts during forcible and possibly prolonged efforts at extraction. It must, however, be borne in mind, that the larger the stone the more probability is there of the existence of old-standing disease of the bladder or kidneys, and an unfavorable result from this cause. Mr. Crosse, of Norwich, has drawn up a table that shows the influence of the weight, or in other words, the size of a calculus on the results of lithotomy. He found that when the stone was one ounce and under in weight, the deaths were in the proportion of 1 in 11·25 cases. When from 1 to 2 ounces in weight there was 1 death in 6·61 cases. When from 2 to 3 ounces 1 death in 2·18 cases. When from 3 to 4 ounces 1 death in 1·57 cases. When from 4 to 5 ounces 1 death in 1·66 cases. This table, which has been constructed on the results of 703 cases, illustrates very clearly the fact, that the operation for the removal of a large calculus, is far more dangerous than that for the extraction of a small one.

The symptoms of diffuse inflammation of the cellular tissue arising from the cause now under discussion, very closely resemble those from infiltration of urine, and the treatment must be conducted on precisely similar principles.

HIGH OR SUPRA-PUBIC OPERATION.

Although the lateral operation for lithotomy is perhaps the safest for the extraction of stones of small or moderate size, yet there can be no doubt that its results are extremely unfavorable, as has already been shown, when the calculus exceeds a certain magnitude; and under these circumstances it may be deemed expedient to perform the high operation in preference to it. It is fortunate, however, that large calculi are comparatively rarely met with. Thus of the 703 Norwich cases, that form the basis of Mr. Crosse's tables, and indeed of our chief information on these points, 529 were under 1 ounce in weight; 119 weighed from 1 to 2 ounces; 35 from 2 to 3; 11 from 3 to 4; 5 from 4 to 5; and only 4 were above this size. Hence if we confine the high operation to those instances in which the calculus is above such a size as will readily admit of extraction through the perineum, we shall seldom have occasion to perform it; but yet instances occasionally occur in which no other method of extracting the calculus presents itself. Thus, by this method, M. Uytterhoeven succeeded in extracting a calculus, of which he has kindly given me a cast, which measured 16½ inches in one circumference, and 12½ in the other, which was per-

fectly moulded to the shape of the inside of the bladder, and which clearly could not have been removed by any incisions through the perineum, as the outlet would have been insufficient for its extraction. The patient survived the operation eight days. But not only may the high operation be required on account of the size of the calculus, it may be rendered necessary by the existence of such rigidity about the hips in consequence of rheumatic disease, as would prevent the proper exposure of the perineum; or, that region might be the seat of disease that would interfere with any operation being practised through it.

The *high operation* consists in making an incision through the abdominal wall, above the pubes, and opening the anterior part of the bladder underneath the reflexion of the peritoneum that passes upwards from its superior fundus.

In performing this operation, it is necessary that means should be taken to raise up the fundus of the bladder, so that it may project above the pubes, and thus admit of being safely opened. With this view various contrivances have been invented, such as catheters containing sliding stylets, which can be pushed through the bladder when that viscus is exposed. These instruments, though ingenious, are not necessary, for the end of an ordinary catheter introduced through the urethra, and made to project above the pubes, would serve as a sufficient guide. In performing the operation, an incision about four inches in length should be carried from the pubes directly upwards in the mesial line. The pyramidales are then to be cut across near their origin, the linea alba exposed, cautiously opened near the pubes, and divided upwards some little way. The peritoneum must next be pushed back and the dissection carefully carried through the cellular tissue above the bone, until the instrument previously introduced can be felt through the bladder, when, if it contain a sliding and pointed stylet, this may be pushed through the coats of the bladder; if not, an incision must be made down upon it, and the aperture in the organ enlarged downwards towards the neck of the bladder by means of a probe-pointed bistoury, so as to admit the fingers. The forceps must then be introduced, and the calculus extracted. After the operation there will always be risk of urinary infiltration into the cellular tissue around the margins of the wound. In order to prevent this, the older surgeons kept the bladder empty by making incisions through the perineum into the membranous portion of the urethra or neck of the bladder, thus complicating seriously the operation; but this accident may best be prevented by introducing a gum-elastic catheter into the urethra, and leaving it there for a few days until consolidation has taken place and the wound shows a disposition to close, pressure being at the same time kept up on the lips of the incision. Another cause of danger in this operation is wounding the peritoneum, which may occur in consequence of the contracted state of the bladder, causing it to lie low in the pelvis, and thus preventing the proper introduction of instruments to carry it up above the pubes.

Mr. Humphrey, of Cambridge, has collected 104 cases in which this operation has been performed; of these 31 proved fatal, chiefly from peritonitis and urinary infiltration, the mortality amounted consequently to 1 in $3\frac{1}{8}$; and M. Sonberbielle, one of the greatest modern advocates of this operation, lost 1 patient in 3. The general result, therefore, is by no means satisfactory, though, as in many instances the operation was performed in cases in which the lateral method was not applicable, we cannot with justice compare the two procedures.

MEDIAN LITHOTOMY.

The *median operation* of lithotomy is that procedure by which a stone is extracted through an incision in the raphe of the perineum, extending into the

urethra behind the bulb. An external incision having been made, and the urethra opened, the membranous and prostatic portions of the canal were forcibly dilated or rather lacerated by specially constructed instruments, until a sufficiently large aperture was made for the introduction of the forceps and the removal of the stone. This operation, under the name of the "Marian," from Sanctus Marianus, one of its inventors, or "the operation of the apparatus major," from the complexity of the instruments used, held its ground in Europe for two centuries, until its tediousness, the terrible pain attendant upon its performance, and the mortality following it, caused it to give way to the lateral operation. It has, however, under various modifications, kept its ground in some schools of surgery, in that of Paris more especially, and has of late years been reproduced in a simplified manner in Italy by Borsa and Mauzoni, and in this country by Mr. Allarton.

With the old Marian operation, which has justly been discarded from surgical practice, we have now nothing to do, but its modern modification deserves some attention.

The steps of the median operation as modified by Mr. Allarton are as follow:— The patient having been placed in the proper position for lithotomy, and a staff deeply-grooved along the convexity introduced into the bladder, the surgeon passes the left index finger into the rectum, and feels for the prostate. He then pushes a long sharp-pointed bistoury, with the edge turned directly upwards, into the mid line of the perineum, a little above the anal aperture, so as to open the membranous portion of the urethra immediately in front of the apex of the prostate. The finger in the rectum serves as a guide to this part of the canal, and prevents the point of the knife wounding the gut, warning the surgeon of its too near approach. When the staff is reached the incision is carried upwards to a sufficient extent. A steel ball-probe is then passed along the groove into the bladder, and the staff withdrawn. The surgeon, using the probe as a guide, now proceeds gradually to insinuate his left index finger along it into the prostatic portion of the urethra and the neck of the bladder, dilating these passages as he proceeds. Having got his finger into the bladder and felt the stone, he withdraws the probe, introduces the forceps, and extracts the calculus in the usual way. This operation is said by its advocates to possess several advantages over the lateral one, being more simple and easy of execution, attended by less hemorrhage, by the dilatation and not the section of the prostate, and admitting of the easy extraction of the stone.

Let us briefly examine these supposed advantages, and compare the mesial and lateral operations.

As to simplicity and ease of execution, there can be little doubt that that operation will be easiest of execution which a surgeon is most in the habit of performing, and in this respect the mesial and lateral appear to me to be much on a level.

With regard to the avoidance of hemorrhage, the mesial has certainly the advantage. If the surgeon carefully cut in the middle line, no blood-vessel of importance can possibly be divided, and even though the bulb be freely incised, we know that, as in the perineal section, no bleeding of consequence is likely to ensue, whilst in the lateral, the artery of the bulb, if not the internal pudic, must always be in some danger; and even from the superficial vessels the bleeding is often very free.

With reference to any difference in the treatment of the prostate, its dilatation in the mesial, and its section in the lateral, I believe it to be in many cases more imaginary than real. In the lateral operation, most surgeons are agreed that the internal or deep incision should be as limited as possible, merely notching the apex of the prostate, and that dilatation should be effected by the pressure of the finger; so in the mesial, the apex of the prostate is notched, and dilatation is effected with the finger. In both cases I believe that the so-

called dilatation is in reality a partial laceration, a breaking down or opening out of the structure of the prostate rather than a true expansion of its substance. I have often examined the prostate in the dead subject after it has been subjected to this process of dilatation, and have always found it more or less torn.

The next point for comparison is as to the relative facilities presented by the two operations for the manipulation of the forceps and the extraction of the stone. In the adult, the main difficulty of lithotomy does not lie in getting into the bladder, but in getting out the stone. And the difficulty and danger increase in proportion to the size of the calculus; the tissues between the neck of the bladder and the perineal integuments must either be widely cut or extensively torn and bruised to allow of the passage of a large stone. No amount of simple dilatation of which these tissues are susceptible can make a passage through them that will allow of the extraction of a stone 1½ or 2 inches in diameter; such a stone must either be cut or torn out. Now what space have we in the median operation for the introduction of the forceps and the extraction of a large stone? Here, I think, is the weak point of the modern operation. In it the incision is made, and all the manipulation is practised towards the apex of the narrow triangle formed by the rami of the pubes. The base of this triangle is represented by a horizontal line corresponding to the level of the membranous portion of the urethra, and consequently does not occupy the widest part of the perineum, and is formed by the transverse muscles of the perineum and the lower portion of the deep fascia, supported and filled up by the rectum and the tissues which are attached to and support the gut on either side, and which form a rigid wall or barrier stretching across the perineum, which cannot be depressed, and which requires to be divided laterally into the ischio-rectal fossa, before a stone of any considerable magnitude can be removed. It was in consequence of the extensive bruising and laceration of these structures, and the difficulty experienced in getting the stone through them, that the old Marian operation fell into disuse. This difficulty, however, is only met with in the extraction of calculi of large size. Small flat or elongated calculi, foreign bodies, such as bits of broken catheter, pencils, etc. may very readily, conveniently, and safely be removed through the narrow space in which the incision of the median operation is carried.

In summing up the comparative merits of the modern median and the lateral operations of lithotomy, I think it may be said that the great advantage possessed by the median is in the absence of all serious danger from hemorrhage, but that the great objection to it consists in the triangular space in which it is performed being too narrow to allow of the extraction of large calculi. In the lateral operation there is undoubtedly more danger from hemorrhage, but this is more than counterbalanced by the greater facility for extracting the stone. In conclusion, I should say that in all cases in which the calculus is large, the lateral operation should be performed; but when of small size, and especially if narrow, whether single or multiple, the median operation, as recommended by Mr. Allarton, might be substituted, provided it be not thought advisable, as is now generally done, to subject such cases to lithotrity; and that, in cases of the lodgment of foreign bodies, especially of pieces of broken catheter, the median possesses advantages over the lateral operation. In the case also of calculi which are too large to be successfully subjected to lithotrity, but which, if removed by the lateral operation, are attended by a frightful rate of mortality, it seems to me that the median operation might possibly be advantageously combined with lithotrity. The stone having been broken up at one sitting, the fragments might at once be extracted through a limited incision, in the mesial line of the perineum.

The *bi-lateral* operation of Dupuytren is a modification of the median. In

it a transverse incision is made across the perineum, half an inch above the anus, the horns of the incision extending to two-thirds of the distance between the anus and the tuber ischii on either side (fig. 385). The dissection is carefully carried down to the central point of the perineum, and the membranous portion of the urethra is opened on a grooved staff previously introduced; along this the double *lithotome caché* is passed (fig. 386), the blades expanded to a proper distance, previously regulated, and both lateral lobes of the prostate divided to a corresponding extent downwards and outwards in withdrawing the instrument. The extraction of the stone is then effected in the usual way. This operation appears to me not to have received the attention from surgeons in this country that it deserves. By it the prostate is divided equally on both sides in its greatest diameter; if the expansion of the lithotome is carefully guarded, there is no danger of going beyond the limits of that organ, or of wounding the internal pudic arteries, and the interior of the bladder is reached by the most direct and the readiest passage. In withdrawing the lithotome, its concavity should be turned downwards and the handle well depressed.

Fig. 385.

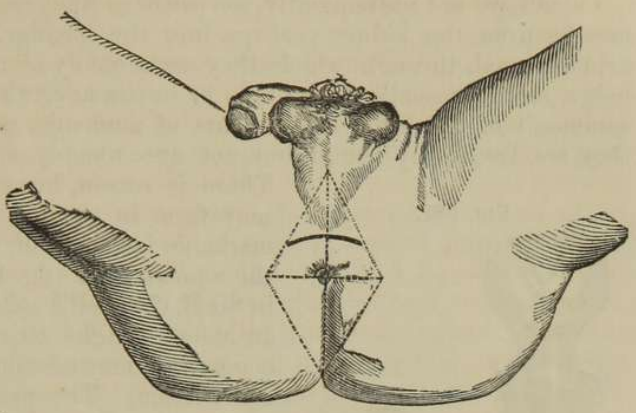
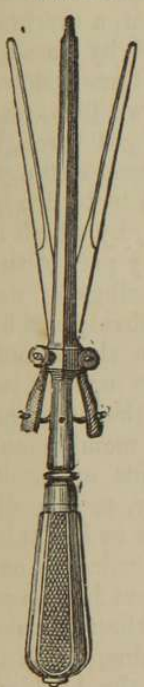


Fig. 386.

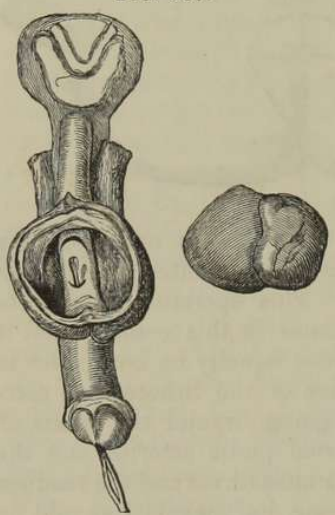


The median and bi-lateral operation might, I think, be advantageously combined, and thus the chief objections to both be got rid of. This kind of operation I have often practised on the dead subject, and it appears to me to be one well deserving a trial on the living. It is easy of execution, seems likely to be attended by little risk of hemorrhage, of urinary extravasation, or of pelvic inflammation, and opens the bladder at the part where it is nearest the perineal surface. It may be performed as follows: The patient having been tied up, and a staff deeply grooved along the convexity passed into the bladder, the urethra is opened at the membranous part with the edge of the knife turned upwards, as described in the median operation; the double lithotome is then slid along the staff into the bladder, its concavity turned downwards, the blades expanded to but a limited extent, and the prostate and the soft structures between it and the surface incised as it is withdrawn. If the stone is of but moderate size, the incision may be confined to one side only, and made with a probe-pointed bistoury. It will be found that sufficient space is obtained by the perpendicular incision in the skin, whilst the limited transverse cut removes that tension and resistance of the deeper structures, which in the ordinary median operation interfere seriously with the manipulation of the forceps and the extraction of the stone, and by the division of both sides of the prostate to a limited extent abundance of space is obtained.

URETHRAL CALCULUS.

Calculi are not unfrequently met with in the urethra, especially in children, passing from the kidney perhaps into the bladder, and from thence into the urinary canal, through which they occasionally escape, but in other instances lodge, more especially at the bulb or in the navicular fossa. These calculi are commonly of the lithic acid, lithate of ammonia, or oxalate of lime varieties; they are frequently round, but not uncommonly elongated or spindle-shaped. There is reason, however, to believe that calculi may form in the urethra. One of the most remarkable instances of this kind is represented in the annexed cut (fig. 387), taken from a drawing in Sir R. Carswell's collection at University College. In cases of tight stricture, sabulous or calculous concretions may occasionally be formed behind the constriction. The presence of a calculus in the urethra may always be determined by the difficulty that is occasioned in micturition, by the possibility of feeling the stone through the walls of the canal, or detecting it by introducing a sound into the urethra.

Fig. 387.



The removal of these calculi may be effected either by extraction or excision. When situated towards the anterior part of the canal, a urethral calculus may frequently be extracted by passing a long and very narrow-bladed pair of forceps down to it, by which it is seized and drawn forwards; occasionally when it has reached the navicular fossa, it cannot be got through the urethral orifice without dilating this by incision with a probe-pointed bistoury. If the calculus is too large to be extracted in this way, and appears to be firmly fixed, an incision may be made down upon it, through the urethra, by which it may be removed. It is a good rule not to make this incision in any part of the urethra anterior to the scrotum, for in consequence of the coverings of the penile portion of the urethra being very thin, the aperture will probably not be closed, but a fistulous opening left. When the stone is situated in the scrotal portion of the urethra, there would be some risk of abscess and of urinary infiltration if the incision were made through the lax tissues of the scrotum. Hence, it is better, if possible, to push the stone back towards the membranous portion of the canal, to cut down upon, and extract it here. This operation may readily be done by passing a staff, grooved, along its convexity, or an ordinary director as far as the calculus, and making an incision upon the end of this, so as to lay open the urethra; the staff is then removed, and the calculus extracted by means of a slender pair of forceps. A catheter should next be passed into, and retained in the bladder for a few days, in order to lessen the tendency to the formation of urinary fistula. It may happen that the calculus, which is impacted in the urethra, is only one of several that are lodged in the bladder. In order to ascertain this, the surgeon should, after removing the calculus for which the operation has been performed, pass a sound into the bladder, so as to ascertain whether any other concretions exist in that organ; and if so, they should at once be removed by extending the incision made into the membranous portion of the urethra into the bladder, by the lateral operation of lithotomy. In this way I once saw Mr. Liston extract two vesical calculi after having removed one that had blocked up the urethra.

PROSTATIC CALCULI.

Prostatic calculi differ from all other urinary concretions in situation and composition, being formed in the ducts of the prostate gland, and composed principally of phosphate of lime and some animal matter; usually about 85 per cent. of the phosphate, to 15 of the organic ingredient. They generally occur in old people, though they may sometimes be met with in young subjects. From a lad of nineteen, whom I cut for vesical calculus, I extracted two of these prostatic concretions.

They are usually of a grey or ashy color, somewhat triangular in shape, smooth and polished (fig. 388); having facets, being very hard, and seldom much larger than a cherry or plum-stone; though they may occasionally attain a considerable bulk, having been met with as large as a hen's egg, and then presenting a branched or irregular appearance. Though usually but one or two exist, which are sometimes deposited in a kind of cyst in the gland, as many as thirty or forty have been met with, its whole tissue being studded with them.

Fig. 388.

Prostatic calculi give rise to a sense of weight, pain, and irritation in the perineum, and often occasion a tolerably free secretion of mucus from the gland. On introducing a sound this passes over them, striking the calculus with a distinct click before its beak enters the bladder. This is increased by the finger in the rectum pushing the gland up, and thus bringing the stone in more direct contact with the sound. In some cases the stone may be felt through the coats of the rectum.

The *treatment* consists in introducing a grooved staff and cutting down upon the prostate in the mesial line, until the calculi are reached, when they may be extracted with the forceps or scoop. When complicated with vesical calculus the lateral or modified median operation should be performed, and the stones removed as they present themselves.

LITHOTRITY.

The operation of lithotrity, by which the stone is crushed in the bladder and the fragments expelled through the urethra, is of modern, and indeed, of very recent invention; for notwithstanding that various rude and incomplete attempts may at different times have been made with this view, it was not until about the years 1818 or 1820 that the subject began to attract serious attention. About this time Civiale, followed by Amussat, Leroy, and others, began constructing instruments, which though very imperfect, yet were sufficient to break down a calculus in the bladder. From this period the system made rapid progress, and the successive improvements made by the surgeons whose names have just been mentioned, together with the ingenious mechanical adaptations introduced by Weiss, Heurteloup, Costello, and Charrière, enabled the surgeon to attack the stone with certainty and effect. It is, perhaps, principally due to the labors of Civiale and Amussat in France, and of Brodie and Liston in this country, that the system has been reduced to its present state of perfection.

Before proceeding to the operation of lithotrity, it is necessary that the patient's constitution should be carefully attended to, and especially that all local irritability about the urinary organs should be subdued by ordinary medical treatment. This is even of much greater importance in lithotrity than in lithotomy. In lithotrity we must always expect that any existing irritation or inflammation of the bladder will be increased by the necessary introduction of instruments and the presence of sharp fragments of calculus in the bladder, and their passage along the urethra; but in lithotomy all source of irritation is at once removed

by the extraction of the stone. Before determining to perform lithotrity then, it is necessary to examine very carefully the condition of the urinary organs, and if these be diseased, it will probably be requisite to abandon the operation.

The conditions that the surgeon has principally to look to before lithotrity is determined on are, 1st, the characters of the stone; and, 2d, the state of the urinary organs. In order that lithotrity should be successful, it is necessary that the stone should not be above a certain size, that it be not too hard, and that more calculi than one do not exist. The urinary organs must also be in a healthy state and free from irritation.

1st. As to the characters of the stone. With regard to the size of the calculus, it may be stated generally, that the smaller it is, the greater will be the success of the operation. As a general rule, it is not well to attempt to crush a calculus above an inch or an inch and a half in diameter. It is not that a large stone cannot be broken; because in most cases, this might readily enough be done; but because the quantity of fragments resulting would be so great that the bladder would in all probability not be able to get rid of them; or, the necessary operations for their disintegration and removal would occasion a dangerous amount of irritation. The size of the calculus may always be readily ascertained by seizing it in the lithotrite, and then measuring it by the graduated scale upon the handle of the instrument.

If there are several stones, lithotrity is not a very successful procedure; for although each calculus may be a small one, yet the aggregate of the whole is considerable; and besides this, the small calculi will each require a separate operation, as it were, and may each contain a hard and possibly very resisting nucleus.

The hardness of the calculus influences materially the question of lithotrity. If the concretion is very hard, especially if composed of oxalate of lime or lithic acid, giving a very clear and ringing sound, the case will not be a very favorable one for crushing. For not only may the density of the calculus be such as to cause it to resist any force that it may be safe to bring to bear upon it; but if broken, it will splinter into sharp and angular fragments which cannot readily be ground down, but will greatly irritate the bladder, and will probably escape with difficulty through the urethra. The most favorable calculi for crushing are those that are soft and friable, as the different forms of phosphatic concretions; though in this diathesis the shattered state of system and irritable condition of the urinary organs often counterbalance the advantage that would otherwise have been derived from the character of the stone.

2d. The conditions of the urinary organs that influence the propriety of performing lithotrity have reference to the state of the urethra, of the prostate, the bladder, and the kidneys.

If the urethra be the seat of stricture, or is very irritable, lithotrity, which may require the frequent introduction of instruments and will entail the continued passage of fragments of calculus, cannot be performed.

If the prostate be enlarged, more particularly if the third lobe is very prominent, the introduction of the lithotrite will be attended by considerable difficulty, and a dependent pouch will be found at the lower fundus of the bladder, into which the fragments of the crushed stone are apt to fall, and from which they cannot be expelled; hence such a condition of the gland as this, is a serious, though perhaps not an insuperable bar to the performance of any crushing operation.

The state of the bladder deserves especial attention; the circumstances connected with it that principally militate against lithotrity are a very irritable condition of it; its being contracted, hypertrophied, or sacculated. A very irritable and sensitive bladder not only will be the seat of severe suffering, but may not admit of holding sufficient water to make the operation a safe one, and may readily become dangerously inflamed in consequence of the repeated introduc-

tion of instruments, and the presence of angular fragments. Hence, if the ordinary operation of sounding occasion much distress; if the patient cannot hold his water long, and passes it in small quantities; if it be bloody, or much loaded with viscid mucus, he will scarcely be able to bear the procedures necessary for the operation. In some instances, however, the irritability of the bladder may be overcome by keeping the patient in bed, and, as Sir B. Brodie recommends, daily injecting tepid water. At the same time it must be borne in mind that the bladder may be in an opposite condition in cases of stone, having fallen into a state of atony; and this, as Civiale has pointed out, may be a source of great danger after lithotrity, the organ not possessing sufficient expulsive power to rid itself of the fragments with which it is encumbered.

A sacculated condition of the bladder is also a serious objection to lithotrity, as not only are the fragments likely to lodge in the sacculi, but these cysts become filled with an offensive puriform fluid, and thus may occasion low or typhoid cystitis, followed perhaps by pyemia.

Lastly, the condition of the kidneys merits special attention. If these organs be much irritated, as indicated by the presence of casts of tubes, or of a considerable quantity of albumen in the urine, or in any other way, the performance of a series of operations in the bladder would be likely materially to increase the mischief in them, and consequently ought not to be undertaken.

The age also of the patient must be taken into account, though lithotrity can doubtless be performed at all periods of life. The small size of the urethra before puberty is such as scarcely to admit of the ready introduction of the necessary instruments, or of the escape of fragments of calculus; and hence it is rarely had recourse to at this period of life. So also at advanced ages the irritable state of the urinary organs, the tendency to the supervention of low cystitis, and the condition of the prostate, are usually such as to prevent the performance of the operation.

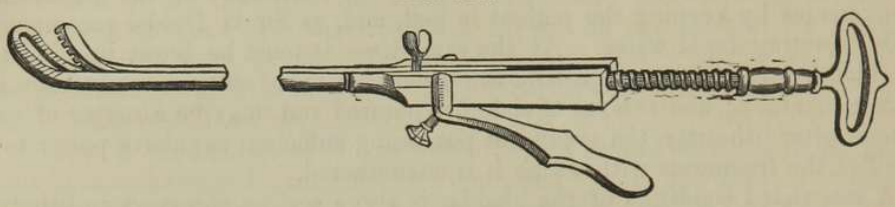
Supposing, however, that a case is met with in which the calculus is of moderate size, single and not too hard, the urinary organs healthy, and not over sensitive, and the patient an adult but not too aged, the surgeon may have recourse to lithotrity with every prospect of readily and permanently freeing the patient of his calculus. In performing the operation in such a case, but little preparatory treatment is needed, though it is well to keep the patient quiet for a few days, and to regulate his bowels before anything is done.

Operation of Lithotrity.—The instruments required for lithotrity are the following: An ordinary sound with a short beak to examine the condition of the bladder. A hollow steel sound, through which the bladder may, if necessary, be injected after or during sounding, without the necessity of changing the instrument (fig. 362). This I have found of especial service in the later stages of the operation for detecting small fragments. A brass syringe, fitted with rings, and having a large piston rod, so that it may work easily; this should admit of adaptation to the hollow sound. A full-sized silver catheter, with large round or oval eyes, and having an elastic gum bougie fitted to its interior, instead of a stylet, to clear it of fragments. This should also admit of adaptation to the syringe. The instruments for crushing the stone and removing the fragments consist of Weiss' lithotrite, as represented in the annexed cut (fig. 389); or a similar instrument worked by a rack and pinion; this, however, has the disadvantage of possessing less power than the straight screw. The lithotrite must be made of well-tempered steel; and should always be tested by being made to crush a piece of sandstone grit, about the size of a walnut. It should be of as full a size as the urethra will readily admit, must have the male blade well serrated, and the female or under blade open at the beak, with an oval aperture through which the detritus of the crushed stone is forced, and thus any entanglement of it between the blades prevented (fig. 389).

The lithotrite should always be cut out of a bar of solid steel, and not, as is

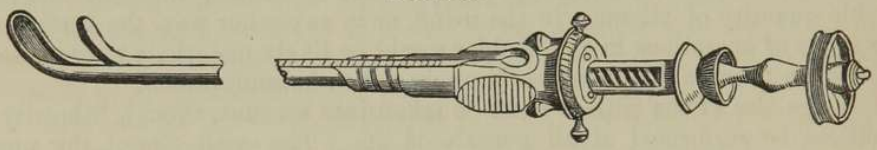
the case with some cheap instruments, be made of a plate of this metal, turned up at the edges; as such a one possesses too little strength to be used with safety. The scoop may, however, be so constructed without danger.

Fig. 389.



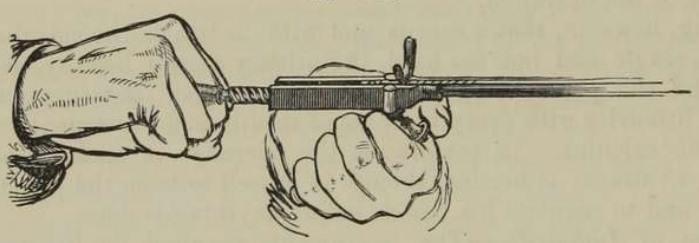
The scoop, such as is represented (fig. 390) and invented by Civiale, has a double action, enabling the surgeon to work it either by the hand or a screw; it is furnished with a kind of spoon-shaped beak, which is somewhat flattened,

Fig. 390.



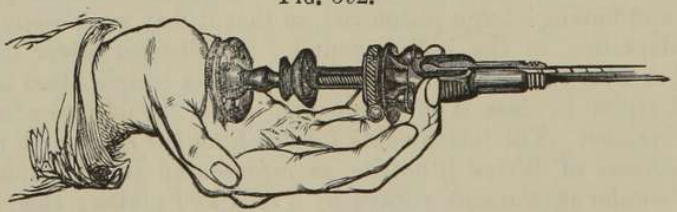
and admits of the extraction of a certain quantity of detritus. Of late, this instrument has been improved by Mr. Coulson, by being made more solid and strong, and having a fenestrum in its beak, so that it can be used as a litho-

Fig. 391.



trite. Besides these instruments, a small lithotrite is occasionally used for crushing fragments in the urethra; and another instrument, shaped like that represented (fig. 131), for withdrawing them from that canal.

Fig. 392.



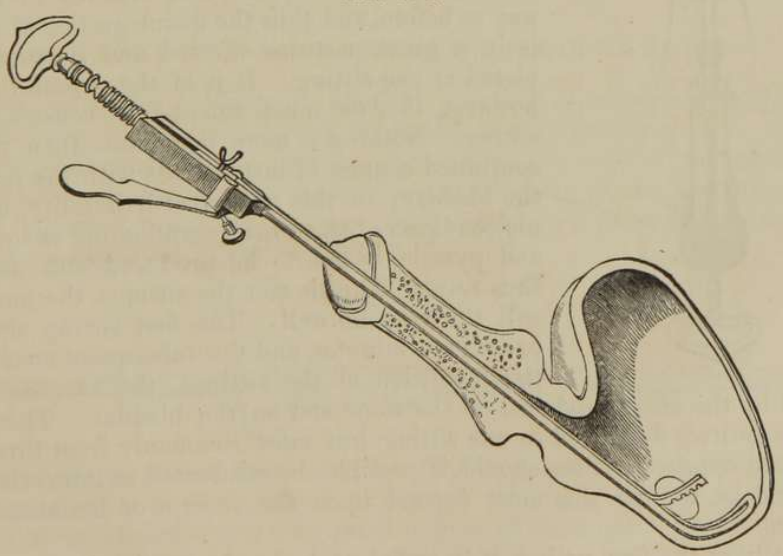
The operation of lithotrity may be divided into three stages. 1st. The introduction of the instrument. 2d. The search for and seizure of the stone. 3d. The crushing of the stone. These we shall consider successively.

1st. Lithotrity may be performed with the patient either lying on his back upon a hard mattress, or a couch or table; or it may be practised, and in some cases most conveniently, in the sitting posture. The surgeon, standing on the right side of the patient, carefully introduces the hollow sound or catheter, and

draws off the urine; he then slowly and very cautiously injects the bladder by means of the brass syringe, with from four to eight ounces of tepid water. The use of drawing off the urine is to make sure of the bladder holding the proper quantity of fluid when it is afterwards injected, and the object in injecting it is to distend it with fluid to such an extent as to prevent the mucous membrane being seized in the grasp of the lithotrite, or injured by the splintering of the stone. The instrument is then withdrawn after the situation of the stone has been detected by it, and the lithotrite is introduced. As this is straight, with a sharp elbow near the beak, some little skill is required in passing it. In doing so, the surgeon must keep his eye upon the short curved beak of the instrument, the direction and position of which must be constantly observed or rather judged of, and especial care must be taken in carrying it under the pubes, not to injure the urethra by pushing the beak of the lithotrite forwards too suddenly, instead of winding it, as it were, under the arch of that bone. In doing this, the instrument should first be introduced nearly parallel to the abdomen, the penis being held between the left fore and middle finger and drawn over it. As the lithotrite passes down, it must be gradually raised to the perpendicular position; and as its curve passes under the pubes, the handle should be depressed between the thighs. The direction of the curve is the thing to bear in mind, and the position of the handle must be varied in accordance with the course that this takes. The lithotrite should be well greased with olive-oil, so that the branch and screw may work smoothly. Lard or ointment should not be used for this purpose, as it is apt to clog and to entangle gritty bits of calculus.

2d. The next point is to search for the stone, which will generally be found in the situation where its pressure was detected during the sounding of the bladder; most frequently at the right side or at the inferior fundus. Should it be situated in a sacculus or depression in this region, it may most readily be seized by introducing a finger into the rectum, and raising up the lower part of the bladder. Sir B. Brodie strongly advises that the lithotrite should never be used as a sound to ascertain the position of the stone; by doing so, the patient suffers pain, the bladder is irritated, the water expelled, and the stone not readily seized. In seizing the calculus, a good deal of tact is required; this

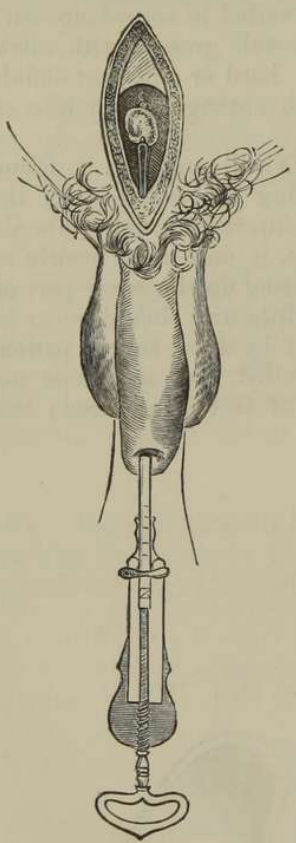
Fig. 393.



part of the operation may generally be best done by pushing the female blade of the lithotrite against the inferior fundus of the bladder, pressing gently down

with it so as to make a conical depression in this situation, and then inclining the beak towards the stone, drawing back the male blade with the thumb (fig. 393); with a slight shake or jerk, the surgeon then tries to get the calculus between the blades at the same time that the male branch is being pushed forwards to seize it. In this manœuvre the female blade should be moved as little as possible, but the stone must be seized by pressing the thumb upon the half circle of steel fixed on the male branch. In this way the stone may often be seized at the first attempt, but in other cases it is not grasped until after several efforts have been made to fix it; the calculus, especially if round, slipping away from between the blades of the instrument, and being merely scraped by them. In these manœuvres all rough handling must be most carefully avoided, and the instrument should be turned about as little as possible. It is far safer to desist in the operation if there be any difficulty in seizing the stone, than to persevere in repeated and fruitless attempts, by which the bladder may be severely injured and inflamed. Rather than do this the patient should be allowed to get up and move about for a few minutes, when the position of the stone may be so far altered that it admits of being seized.

Fig. 394.



3d. When the stone has been seized, it is gently raised in the grasp of the lithotrite, so as to be placed about the middle of the bladder, and it is then crushed. This important step of the operation, like all the others, requires to be deliberately and carefully done (fig. 394). If Civiale's improved lithotrite be used, the stone, if small, may readily be crushed by the pressure of the hand alone, without the action of the screw (fig. 392). If, by the ordinary lithotrite, it should not be effected by suddenly and forcibly screwing up the instrument, but the screw should be gradually worked by a series of short and sharp turns, so as to constitute almost percussive movements (fig. 391). In this way, the calculus is generally made to crumble down, rather than to fly asunder, and as it yields, the screw must be worked tightly home. The blades of the instrument may then be opened again, a fragment of the broken calculus seized and crushed in the same way as before, and thus the disintegration of the stone is in a great measure effected and sometimes completed at one sitting. It is of the greatest moment, however, that too much time be not consumed at one sitting. Nothing is more dangerous than the long-continued contact of instruments with the interior of the bladder; in this way great irritability, or an atonic condition of this organ, terminating in low cystitis and pyemia, is apt to be produced, and death may thus result. The shorter the sittings, the more likely will the case do well. The first sitting should not exceed ten minutes, and the subsequent ones five. In the repetition of the sittings, the surgeon must be guided by the effect produced on the stone and on the bladder. The calculus may be entirely destroyed in one sitting, but most commonly from three to five or six are required; these should, if possible, be conducted at intervals of three or four days, though this must depend upon the amount of irritation induced by them.

Usually at the first sitting, it is sufficient to break up the stone; the fragments being left to be dealt with subsequently. In crushing these, especially when they lie behind the prostate, M. Civiale turns the concave part of the

beak downwards, and seizes the fragment in this position. In doing this, however, great care must be taken not to nip the mucous membrane of the bladder.

Before withdrawing the lithotrite, the surgeon must be careful to see by the scale on the handle, that the male blade is well home. If this be not the case, and the instrument be enlarged by any fragments or detritus being entangled between the blades, laceration of the neck of the bladder or urethra might occur in attempting to withdraw it.

After the stone has been crushed, but little detritus will usually escape during the first twenty-four hours, but after this it begins to be expelled; in some cases, in considerable quantity each time the urine is passed. In others, it does not escape so readily, and then the surgeon requires to introduce the scoop (fig. 390), by which he can seize the smaller fragments, crush them up, and screwing the instrument home, extract the beak filled with detritus. In using this instrument, care must, however, be taken not to get hold of too large a fragment, for in breaking this up, whether by the hand or screw, the beak may be clogged with the detritus in such a way that it does not readily close, and then there might be considerable difficulty in withdrawing it. Should this accident occur, the scoop may be emptied by passing its beak back into the bladder, tapping sharply upon the instrument, and moving the male branch to and fro.

After each sitting, the bladder should be washed out by injecting it with tepid water through a catheter with large eyes; or, what is better, a double-current catheter. In using the latter instrument, the point of which should be directed towards the inferior fundus, a considerable quantity of water may sometimes with advantage be pumped through the bladder by adapting a flute-valve syringe to it.

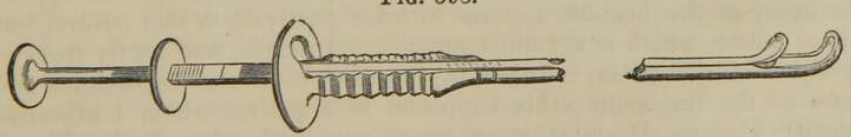
When the surgeon believes that he has pretty well emptied the bladder of the detritus, he must carefully explore the organ by means of a short-beaked or hollow sound; and if he detect any fragment, however small, it must be seized, crushed, and removed with the scoop.

During the whole of the treatment, it is necessary to adopt means to allay irritation; with this view the patient should be kept in bed, or on a couch, a moderate diet only should be allowed, plenty of demulcent drinks given, such as barley-water, soda-water, or milk, and opiates or henbane, if necessary, exhibited.

ACCIDENTS AND DANGERS OF LITHOTRITY.

In considering the accidents of lithotrity, I put out of consideration those that may arise from the surgeon acting carelessly or with improper force, and thus occasioning laceration of the urethra, or injury to the coats of the bladder; so also accidents occurring from the bending or breaking of the instruments will scarcely happen if these have been properly tested on a piece of sandstone grit before being employed in the bladder.

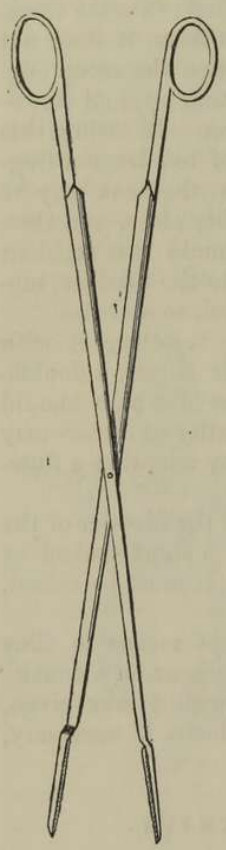
Fig. 395.



The most dangerous accident arises from the *impaction* of some of the angular fragments of stone in the urethra. They are especially apt to lodge about the bulb, and there give rise to a very great degree of irritation, and even of fatal mischief, producing great constitutional disturbance of an irritative and asthenic type. When the fragments are impacted low down in the urethra, it is absolutely necessary to remove them from the canal as speedily as possible.

lest the constitutional disturbance occasioned by them prove fatal to the patient. This may be done in various ways; it has been proposed to push them back into the bladder with a soft bougie, or by injecting a stream of water into the urethra through an open-ended catheter; but these devices are not very likely to be successful, and may give rise to risk of laceration of the urethra. It has been proposed to crush them in the urethra with a small lithotrite (fig. 395); but this plan is somewhat hazardous, as it is very difficult to avoid pinching up the mucous membrane of the canal with the bit of stone.

Fig. 396.



The safest practice seems to be, either to extract them through the urethral orifice, or to cut them out through the perineum. Extraction through the urethral orifice may be effected by the forceps (fig. 396), or by Civiale's instrument (fig. 131). Should this means fail, or should the fragment be very deeply seated, as in the membranous portion of the urethra, the better plan would be to make an incision directly down upon it, and to remove it through the perineum. If such an operation as this be required, the surgeon might possibly feel disposed to extend the incision a little, and empty the bladder of any remaining detritus by means of a scoop.

The principal dangers in lithotrity arise from the state of the bladder and kidneys; — by the induction of cystitis of a low form, atony of the bladder, or renal irritation, or by the occurrence of pyemia, with much constitutional disturbance of a low type.

Cystitis may occur in consequence of the increased irritation to which the bladder is subjected. When it sets in it speedily assumes a low form, and is apt to prove fatal by the induction of typhoid symptoms; even if it do not do so, its occurrence is an insuperable obstacle to the further crushing of the stone, and in such cases as these, the best course that could be pursued would be, after getting the patient into as favorable a state as possible, to remove the fragments by lithotomy.

Atony of the bladder is one of the most dangerous conditions that can occur in lithotrity. This state of things happens usually in elderly people, in whom the urinary organs may appear to be in a peculiarly quiet and favorable condition before the operation, the patient being able to hold his water for six or eight hours, and to bear the injection of ten or twelve ounces of fluid. Under these circumstances the surgeon should be upon his guard, for the danger of this condition is, that the bladder does not possess sufficient contractile power to expel the fragments. These consequently accumulate in the lower fundus, and irritate the mucous membrane, and thus the foundation may be laid for fatal cystitis, which in these cases always assumes a typhoid type.

The atony of the bladder appears to arise partly from that natural want of expulsive power, which is not unfrequent in old people, and partly from a kind of paralysis of the organ, induced by the contact of the instruments and the pressure of the fragments; this happened in a patient whom I lithotrized at University College Hospital some years ago, and who died with severe constitutional depression, and with pyemic symptoms.

When atony of the bladder has come on, it is essential that the surgeon should rid the patient of the fragments which he is unable to expel. This may sometimes be done by means of the scoop, assisted by washing out the bladder through the double-current catheter, but the safer plan would probably be to get the patient into as good a condition as possible, and then cut him. This I

once did in an interesting case under my care at the hospital; the patient, an old man, had been lithotrized by a surgeon out of doors a few weeks before admission, but no fragments had passed; on sounding him, I found a moderate-sized calculus, with what appeared to be a large mass of soft concretion, of the nature of which I was not aware until after its removal; the patient having concealed the fact of his having been lithotrized. On cutting him in the usual way, I removed a lithic acid calculus about as large as a pigeon's egg, and a handful of fragments of another calculus of the same composition, which had been crusted over and matted together by phosphatic deposit. The patient made a very good recovery.

Irritation of the kidneys, giving rise to suppression of urine, occasionally occurs. In such cases, cupping the loins, and the warm hip-bath, would be the proper treatment to pursue.

Very considerable constitutional depression occasionally follows the operation of lithotrity, the pulse becoming quick, feeble, and intermitting; the skin hot and dry; and the tongue brown. This condition is apt to prove fatal either directly or by intercurrent visceral mischief; it appears to arise in many cases from causes independent of the operation, or that are called into activity by the shock and slight constitutional disturbance induced by it. This is more especially apt to happen when there is latent disease of the kidneys. In other instances, again, it is more directly dependent on the irritation induced by the operation being the result of the formation of abscess in the neighborhood of the prostate, or around the neck of the bladder; and in other instances, again, from the supervention of unhealthy suppuration in some of the sacculi that are occasionally met with in this organ; — from whatever cause arising, this condition is usually eventually fatal by the supervention of pyemia.

COMPARISON BETWEEN LITHOTOMY AND LITHOTRITY

Lithotomy and lithotrity differ so entirely from one another in principle and detail, that it is useless to attempt to establish a comparison between the different steps of these two operations. It is, however, a question of very considerable importance and interest to ascertain by which operation a patient can most safely have a calculus removed from his bladder. In determining this point, it is not only necessary to make a comparison between the general results of cases that have been subjected to the two procedures, but more especially to determine those circumstances that influence the result of either operation in particular cases — to determine, in fact, in what cases lithotomy, and in what lithotrity, holds out the best prospect to the patient. It is, I think, in the highest degree unpractical to enter into a discussion as to which should be the general method of treatment in cases of stone. Both operations have been reduced to great simplicity and certainty; but neither should be exclusively practised. It is undoubtedly the duty of the surgeon to make himself familiar with the practice of both, and to adopt that one which promises best in the particular instance with which he has to do. If, however, I were called upon to say which operation I consider most generally applicable, then I should unquestionably answer lithotomy. But yet there can be no doubt that there are many cases in which lithotrity is the preferable method; and in those in which lithotomy or lithotrity may be done with an equal chance of success, the preference should, I think, be given to the crushing over the cutting operation.

The statistics that are before the profession do not represent the true state of the question, so far as a general comparison between the operations is concerned. For it must be borne in mind that those cases that are lithotrized have invariably been picked cases; whilst lithotomy has been performed on almost all patients as they have presented themselves. It has already been stated

(page 934) that for lithotrity to be successfully done, it is necessary that the stone be of moderate size, single, not too hard, and that the urinary organs be in a healthy state and free from irritation. And this is the state in which most of the cases have been in which crushing has been done. In lithotomy cases, on the other hand, the surgeon has had to contend with all the difficulties of large or multiple calculi, diseased bladders, and bad constitutions. Hence on comparing the statistics of the results of lithotrity with those of lithotomy, we compare the statistics of the results of operations performed under the most favorable circumstances on a series of selected cases, with those of cases taken indiscriminately and often presenting most unfavorable conditions.

Another cause of uncertainty with regard to the statistics of lithotrity is, that those we possess are chiefly from a professed lithotritist, M. Civiale, the accuracy of which has been denied in a very decided and emphatic manner by many of the leading surgeons in Paris, who have inquired fully into the matter; and the conclusions from which must necessarily be received with much hesitation in this country, where it is difficult to arrive at the real truth of the statements advanced on either side.

If we compare Civiale's statistics of lithotrity with those of lithotomy, as practised by the most skilful surgeons, Cheselden, Liston, and the Norwich operators, we should at once decide in favor of the crushing method; for Civiale states that out of 591 operations he had but 14 deaths, or 1 in 42·2; whilst, as we have seen, the most skilful lithotomists in this country, where the results of the cutting operation have been far more successful than elsewhere, can only boast of such a rate of mortality as 1 in 7·9, or at most in 10. But though the success is thus stated by Civiale to have been great in his own cases, the accuracy of this statement has been denied by other French surgeons, and it is certainly very different to what has occurred elsewhere. Thus of 162 cases operated upon by lithotrity by various surgeons in Paris, Civiale states that death resulted in 38, and a cure in 100 instances; the results of the remaining cases being unknown, or the cure incomplete. In this country it is impossible to say, even approximately, what the average mortality after lithotrity has been; those surgeons who have had most experience in this operation not having published any account of their cases; but I believe there is a pretty general feeling that in the different London hospitals in which it has been performed, lithotrity has not been a very successful operation. The same remark appears to hold good with regard to the Parisian hospitals; Malgaigne estimates the mortality from lithotrity in those institutions at 1 in 4, while he calculates that of private cases at 1 in 8. The difference between the results of this operation in hospital and private practice can easily be accounted for by the difference in the constitutions of the patients, and by their applying for relief in private in a less advanced form of the disease than in hospital practice. We find the same hold good with regard to the results of lithotomy. Thus Mr. Coulson states that Dr. Dudley lost only 1 in 36 of the *private* patients that he cut; Dr. Mettauer, 1 in 36½; Mr. Martineau, 1 in 42; and Dr. Mott, 1 in 50. These results are fully as favorable as Civiale's statistics of lithotrity, and show the influence that the constitution of the patient, and a proper selection of cases may exercise upon the results of the cutting operation. The only statistics of lithotrity that we at present possess are those given by Sir B. Brodie, as the result of his practice, chiefly on private patients. That eminent surgeon states, that out of 115 cases of lithotrity,—not all, however, on different individuals, the operation having been repeated more than once on several of the patients,—he lost 9. Of these, death was directly attributable to the operation in 5 instances, and in the remaining 4, appeared to be dependent on organic disease, brought into activity by the shock of the operation.

Lithotrity, as has already been stated, cannot be applied to all cases of stone, but in many that are unsuited to this operation, lithotomy may be done with

success. In some cases, however, no operation can be practised in consequence of serious disease of the genitals, bladder, or kidneys, or of some visceral mischief that would necessarily interfere with the performance of any capital operation. The necessity of *selecting* cases of lithotrity is well instanced by a statement that Civiale has given with reference to this point. This dexterous lithotritist considered that of 838 calculous patients that applied to him during a series of twenty years, only 548 were fit cases for lithotrity, and 290, or more than one-third, were not operated on by this method; of the last 332 cases included in this list, 241 were lithotrized, 1 in 3·6 being considered unfit for that operation. Of the 91 cases not crushed, 28 were cut, and in 8 others lithotrity and lithotomy were combined. Of these 36 cases subjected to lithotomy, M. Civiale lost 18, or exactly one-half. These figures show that lithotrity cannot be considered the general operation for stone; but must, even in the hands of the most dexterous and successful practitioners, be in many instances replaced by the cutting operation.

The circumstances that must chiefly determine the surgeon in the selection of the particular operation that is to be performed are, 1st, the age of the patient; 2d, the size and character of the stone, and 3d, the conditions of the urinary organs.

1st, the age of the patient is an important element. As a general rule it may be stated, that it is at the middle and advanced periods of life that lithotrity is most successful, whilst at early ages lithotomy is the preferable operation. The success of lithotrity at advanced periods of life is as good as in middle age, and has been very great in the hands of some surgeons. Thus, Segalas states, that of 14 octogenarians whom he lithotrized he did not lose one; and of 27 septuagenarians, but two. Lithotomy, on the other hand, is extremely fatal in aged persons. In children, under or about the age of puberty, lithotrity is a difficult operation, though it may be performed even at very early periods; but the small size of the urethra and the restlessness of the child interfere materially with the success of this operation. Lithotomy, on the other hand, is so successful an operation in children, that the surgeon would probably gain nothing by substituting lithotrity for it. Thus, of 35 children under ten, operated on by Cheselden, but one died; and of 58 cases of children operated on at St. Thomas's, but one proved fatal, and the average mortality in them is not more than about 1 in 14 cases. Hence, lithotomy, being probably equally safe and far speedier, should be preferred to lithotrity in all cases under about twenty years of age.

2d. The size and character of the stone influence in a very important manner the choice of an operation. Surgeons generally recognize the fact that a small stone is more favorable to lithotrity than a large one, and that the operation should not be undertaken if the calculus exceeds one and a half inch in diameter. Below one inch in diameter all calculi may be crushed, provided other circumstances are favorable. Much, however, will depend upon their composition. Phosphatic calculi of larger size may even readily be crushed, and thus be got rid of. Lithic acid concretions, the fragments of which do not disintegrate, but split up into sharp and angular spiculæ and scales, do not, if large, admit of lithotrity. Oxalate of lime calculi, occurring as they do chiefly in young people, comparatively rarely require lithotrity, but, when crushed, break up very readily, and, as there is usually a co-existing healthy state of the urinary organs, the cases have a favorable issue. Some of the French lithotrizers are in the habit of breaking up friable phosphatic calculi from fifteen to twenty lines or more in diameter; but stones of this size are, I think, usually and more prudently subjected to lithotomy in this country. The existence of several calculi, even when small, though not a bar, is yet an objection to lithotrity, for reasons already stated.

3d. The condition of the urinary organs is perhaps of more importance than

the size and character of the stone. As a general rule, it may be stated that the greater the irritability and inflammatory tendency of these parts, the less successful will lithotrity be. The repeated introduction of instruments, however carefully and skilfully conducted, the presence of fragments of calculus, and their tendency to impaction or entanglement in the urethra, necessarily dispose to inflammation even in the most favorable cases, and very readily excite it, if there be any tendency to such action existing in the parts. If, however, the stone be of small or moderate size, friable, the bladder healthy, and with good contractile power, the urethra capacious, and the patient of sound constitution and quiet temperament, the stone may often be broken up and the fragments expelled with remarkably little suffering. In fact, under a combination of favorable circumstances such as these, lithotrity ought unquestionably to be preferred to lithotomy.

If, however, the bladder be very irritable, or if the patient's constitution is an excitable one, so that he does not bear the introduction of instruments well; and more particularly if it be found that this local and constitutional sensitiveness, instead of being blunted by the methodical introduction of sounds or bougies, is rather increased by them; and especially if the stone be of a medium or large size, so that several sittings would be required before the fragments could be expelled,—lithotomy should be had recourse to.

The existence of organic disease, however, about the urinary organs, constitutes the greatest obstacle to lithotrity, and when extensive must form a complete bar to the performance of that operation. It is not easy, however, to determine the amount of local disease that should thus be held to contra-indicate lithotrity. On this point the opinions of surgeons differ much, and it is particularly in the management of these cases that the advantage of that tact and dexterity in the use of the crushing instruments, which habit can alone give, is so well exemplified.

Organic disease of the kidneys is a more serious obstacle to lithotrity than to lithotomy, on account of the prolonged nature of the operation, and the greater liability to sympathetic or propagated irritation in these organs, giving rise to purulent nephritis. It is not only by the operation increasing the renal mischief that harm might result, but rather in consequence of the tendency to low and diffuse inflammation, to pyemia, etc. that always co-exists with kidney disease.

A chronically inflamed state of the bladder, more particularly if the organ is thickened and fasciculated, so that it will not bear the injection of a few ounces of tepid water, seriously interferes with the success of lithotrity. If the bladder be sacculated, there will be a still greater risk of an unfavorable result, these sacculi not only retaining fragments of calculus, but also becoming the seats of unhealthy inflammation, in consequence of which typhoid cystitis of a very serious character, followed by pyemic symptoms and metastatic abscesses, may result. In such cases as these, lithotomy offers the only chance to the patient. The existence of a moderate amount of vesical catarrh, if the bladder is otherwise healthy, is no objection to lithotrity.

Atony of the bladder is a serious inconvenience, and a great source of danger in lithotrity. It cannot well be positively ascertained, though it may be suspected if the patient can hold his water for a great many hours, and can bear without complaint the injection of a large quantity — eight or ten ounces — of fluid, the interior of the bladder feeling large and smooth to the sound. This condition chiefly occurs in old men of feeble habit of body; and, if ascertained, should call for the performance of lithotomy.

In encysted calculus, lithotrity is for obvious reasons inadmissible.

Moderate enlargement of the prostate, such as is habitually met with in elderly people, does not necessarily prevent the performance of lithotrity, though it undoubtedly complicates the operation and increases its difficulties,

the fragments having a tendency to become lodged in the lower fundus behind the enlarged gland. This more especially happens if the middle lobe is enlarged, and, under these circumstances, though the stone may undoubtedly be crushed, yet the fragments would probably require to be removed by the scoop; the operation would consequently be very tedious and prolonged, and lithotomy would probably be found to answer best. Any inflammatory disease or abscess of the prostate must necessarily prevent the performance of lithotrity.

Stricture of the urethra does not prevent the performance of lithotrity, but only retards the operation until the constriction can be properly dilated. Should this, however, not be practicable to the full extent of the urethra, lithotomy on a small staff must be practised.

I have said nothing, in this comparison between lithotrity and lithotomy, of the comparative painfulness of the two operations; for, as chloroform may be administered with equal advantage in both sets of cases, there is little difference in this respect, except that perhaps the advantage lies on the side of lithotomy, as being the shorter proceeding.

From all that precedes, then, it would appear that useful as lithotrity unquestionably is in many cases, it cannot be looked upon as a general means of treating stone in the bladder; being only applicable under very favorable circumstances; and that a large number of cases will always be left in which lithotomy offers the sole means of relief.

Recurrence of calculus after operation may take place from three distinct causes—1st, in consequence of a continuance of the constitutional condition, or diathesis, under the influence of which the calculus was originally formed; 2d, from the descent of a renal calculus; and 3d, from a fragment of calculus having been accidentally left behind.

Relapse from the first cause is probably not very common, but its occasional occurrence shows the necessity of continuing constitutional treatment adapted to the particular diathesis, after the removal of the calculus from the bladder. It is relapse from this cause that probably occurs in cases of lithotomy, though even in this operation a fragment of calculus may accidentally be broken off during extraction, and left behind. Yet such an accident is not very frequent; for if the calculus happens to be broken during extraction, the fragments, if not completely cleared out of the bladder, will usually be washed away through the wound by the flow of urine. The registers of the Norwich Hospital show 1 relapse in 58 cases; and those of Luneville, 1 in 116 cases of lithotomy (Coulson).

In lithotrity, on the other hand, relapse is far more common. In the practice of M. Civiale it has occurred about once in every tenth case. This must evidently arise from some fragment of calculus having escaped detection and being left behind, thus constituting a nucleus for a fresh formation. The frequency of the occurrence of secondary calculi after lithotrity, even in such practised hands as M. Civiale's, certainly constitutes an objection to that operation, and shows the necessity of the surgeon most carefully examining the bladder before he pronounces the patient cured; and even then watching him for some length of time, in order to meet the calculus at its first formation, and to adopt means for its early removal.

In the event of a secondary calculus forming, whether after lithotomy or lithotrity, most surgeons would feel disposed to extract it by the cutting operation. If lithotomy have previously been performed, this may be done again in the usual way, through the cicatrix left by the former wound; or the surgeon may adopt Mr. Liston's advice to cut through the right side of the perineum on a staff with a groove to the left of its convexity. As this procedure, however, would entail the use of the left hand for cutting and extracting, most surgeons would, I think, prefer either the operation through the site of the old wound, or else the mesial operation. Whatever procedure, however, is adopted, it should

be borne in mind that the rectum may have become pretty firmly adherent to the membranous portion of the urethra and the apex of the prostate, in consequence of the contraction of the old cicatrices, and may thus be endangered.

CALCULUS IN THE FEMALE.

Stone is of rare occurrence in women; in London, certainly, I believe it is not often met with. Thus, South states, that during a period of twenty-three years, 144 males were operated on for stone at St. Thomas's Hospital, and only 2 females. In some districts, however, stone would appear to be more common in women than this:—Thus, according to Mr. Crosse, at the Norwich Hospital, the proportion has been about 1 woman to 19 men. Civiale states, as the result of his researches, that in the North of Italy, the proportion is as 1 to 18; and in France, as about 1 to 22. Calculus in women is most frequently deposited upon foreign bodies, accidentally or purposely introduced into the bladder, such as pins, pieces of pencil, &c.

At the University College Hospital we had not had a case of stone in the female for many years until 1855, when three came under my care in the course of a few months.

The *symptoms* of stone in the female closely resemble those that occur in the male, and its presence may usually be easily detected by means of a short and nearly straight sound, or a female catheter. It is often simulated very closely by the irritation occasioned by a vascular urethral tumor, or by an irritable bladder, but exploration of the viscus will always determine the diagnosis.

Calculus in the female bladder, if allowed to remain unrelieved, will not only occasion the various morbid conditions in the urinary organs that have been described as following the long-continued presence of stone in the male, but will give rise to diseased states peculiar to the female. Thus the stone may be spontaneously discharged through the urethra: if of small size, without any bad results following; but if large, by a process of ulceration, in consequence of which permanent incontinence of urine will remain; or it may slough through into the vagina; or lastly, it might offer a serious obstacle during parturition to the descent of the fœtal head, when if it could not be pushed aside to be dealt with afterwards, it must be cut out or craniotomy be performed.

A stone may be extracted from the female bladder by one of three methods: 1st, lithectasy, through a dilated urethra; 2d, by lithotomy; 3d, by lithotrity. These different operations cannot be employed indiscriminately, but each one is more especially adapted to certain kinds of calculus.

1st. *Lithectasy* may be performed in two ways—either by simply dilating the urethra by means of a sponge tent or dilator, or else by incising the mucous membrane at the same time that the canal is being expanded.

α. *Simple dilatation* of the urethra may be effected quickly by the introduction of a tent of compressed sponge, or a three-bladed dilator which is rapidly screwed up. In this way in from two hours to a few minutes the canal may be easily dilated sufficiently to admit of the introduction of a pair of forceps, and the extraction of a calculus of moderate size. Some surgeons prefer a slow process of dilatation, continued through many hours; but this appears to me to possess no advantage over the more rapid expansion, and has the very decided disadvantage of prolonging the patient's sufferings. The plan that I have adopted with most success is to introduce a sponge tent two hours before the intended extraction, and then, when the patient is under chloroform, to dilate the urethra to the required extent, with a two or three bladed dilator.

β. Incision may be employed conjointly with dilatation, in order to prevent injurious stretching of the urethra, and consequent laceration of its mucous membrane. The incisions recommended with this view should be made after the urethra has been dilated to some extent; a probe-pointed bistoury being in-

troduced by the side of the canal, and the mucous membrane divided. Brodie makes an incision directly upwards, Liston downwards and outwards on either side; on the whole, I think, the best direction for the incisions, as more space may thus be obtained.

By dilatation, either alone or with incisions of the mucous membrane, small stones may readily be extracted; but in the removal of moderate-sized calculi, the great objection to this operation is the liability to incontinence of urine resulting from it. It is difficult to say to what extent the urethra may be dilated without incontinence resulting; this must necessarily vary in different individuals. It certainly can be expanded sufficiently to admit of the introduction of the index finger, and to allow of the extraction of a stone eight or ten lines in diameter, without any evil resulting. The incontinence of urine that may be left after the removal of larger calculi than this may not be by any means complete; but a weakened state of the sphincter of the bladder results, so that the patient cannot hold her water for more than an hour or two at the most.

2d. *Lithotomy* in the female may be performed in a variety of ways. There are, however, only two modes of practising this operation that appear to me to deserve serious attention, viz., the *supra-pubic* and *vaginal*. The *supra-pubic* or *high* operation in women differs in no very material respect from the same procedure in men; except that it requires additional care in consequence of the difficulty there is in causing the female bladder to retain a sufficient quantity of urine to make the viscus rise sufficiently above the pubes. The extraction of the stone is easy, as it can be raised into the grasp of the forceps by being pushed up from the vagina.

Vaginal lithotomy is an operation easy of performance. It may be practised by passing a straight grooved staff into the bladder, pressing the end well down against the anterior wall of the vagina, and fixing it there with the left index-finger. A scalpel is then pushed through the anterior wall of the vagina and inferior fundus of the bladder into the groove in the staff, which it is made to enter just behind the urethra, and is then run backwards for about 1½ inch; through the aperture thus made the forceps are passed, and the stone extracted. This operation is necessarily followed by a vesico-vaginal fistula, which will be required to be closed by a subsequent plastic procedure.

Of these two methods the high operation is, I think, the preferable. With care, there would be but little risk of injuring the peritoneum, and the chance of urinary infiltration, which is a serious objection in the male, may be prevented in the female by the introduction of a syphon catheter into the urethra. The vaginal operation, though easier of performance, is open to the objection of leaving a permanent urinary fistula. It may, however, be the only alternative. In a case recently under my care, I extracted a calculus measuring eight inches by six in circumference, from the bladder of a young woman, by this method. The stone having by its size offered so serious an obstacle to the descent of the fœtal head during parturition, that craniotomy had been rendered necessary; the anterior vaginal wall had been a good deal bruised, and I feared that sloughing of it might take place, hence I extracted the stone by the vaginal method.

3d. *Lithotrity* in the female requires to be practised on the same principles as in the male. The details of the operation differ, however, in some important particulars. The chief difficulty in the performance of the operation in the female consists in causing the bladder to retain urine or water that is injected into it. In consequence of this there is not only great difficulty in seizing the stone, the bladder collapsing and falling into folds around it, but also danger of injuring the mucous membrane with the lithotrite. In order to cause the bladder to retain the necessary quantity of urine, the pelvis must be well tilted up, and the urethra compressed against the lithotrite. It is well not to dilate

the urethra before the introduction of the instrument, as the incontinence is thereby increased.

The ordinary male lithotrite is not a very convenient instrument to use in the female bladder, the handle being awkwardly long. This is especially the case in female children. Hence I have found it convenient to have a shorter instrument constructed, with which it is far more easy to manipulate in the female bladder. If urine or water cannot be retained, the calculus may more safely be seized and crushed by means of a small and strong-bladed pair of forceps; or if the stone be larger, a crushing instrument, made of the shape of that depicted (fig. 384), but smaller and lighter.

After the stone has been crushed, the urethra (unless this has previously been done) may be dilated by means of the two-bladed instrument to a moderate degree, and the larger fragments removed by means of a pair of slender forceps. The shortness and wide capacity of the female urethra will readily allow of the escape of the detritus.

For all calculi in the female bladder, except those of the very largest size, this operation is the most applicable. By it the stone may be removed piecemeal as it were, without the necessity of dilating the urethra to such a degree as to incur the risk of incontinence of urine resulting. Lithotrity may be had recourse to at all ages, in the very young as well as the old; I have crushed and successfully removed a large calculus in a child three and a-half years of age. Although the urethra of a female child is not very dilatable, yet it can readily, by means of a sponge tent, be enlarged sufficiently to admit a from 11 to 12 lithotrite.

CHAPTER LIX.

DISEASES OF THE PENIS AND SCROTUM.

THE penis is liable to certain malformations. Thus it occasionally happens that there is an arrest of union in the mesial line, so that a slit or fissure is left communicating with the urethra. This gap commonly occurs on the under surface of the organ, constituting *hypospadias*, and is confined to the glans and anterior part of the penis, though it occasionally extends backwards to the root of the organ, and then may be associated with some of those kinds of malformation that are erroneously considered as examples of hermaphroditism. These conditions are mostly incurable, though plastic proceedings have occasionally been devised for their relief.

FIG. 397.

The upper surface of the penis is less frequently fissured; only, I believe, in cases of extroversion of the bladder. This condition, termed *epispadias*, may be looked upon as incurable.

The *prepuce* is not unfrequently the seat of malformation or disease. That condition of it in which it is so much elongated that it extends beyond and covers in the glans, and at the same time so much contracted that it prevents the proper exposure of this portion of the organ, is termed *phymosis*. This may be either congenital, or acquired, as the result of inflammation or disease.

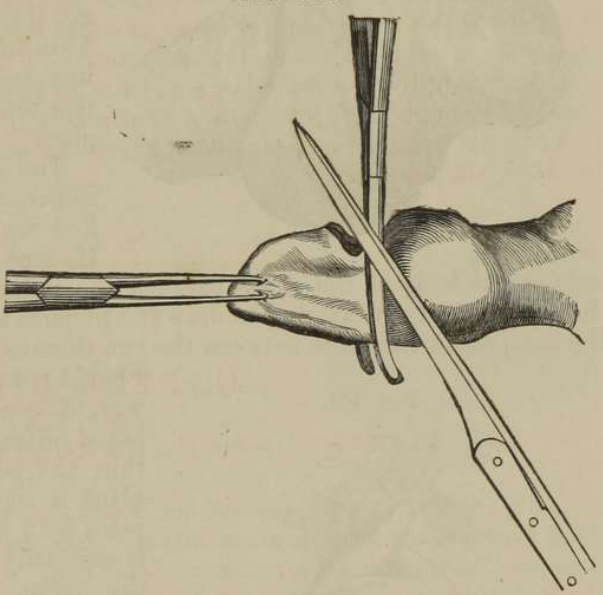
In the *congenital phymosis* the penis is usually somewhat atrophied, and the development of the glans prevented by the pressure of the

narrow prepuce. In the majority of cases this condition is simply a source of inconvenience, but it may become a source of disease from the retention of the sebaceous secretion of the part, setting up irritation and repeated attacks of inflammation (fig. 397). Congenital phymosis especially becomes a source of inconvenience if any gonorrheal or venereal disease is contracted, as it renders the exposure of the diseased part difficult or impossible, and interferes with the necessary treatment.

Phymosis that is acquired has usually resulted from repeated attacks of inflammation, or of specific disease in the part, giving rise to solid œdema, or false hypertrophy of the prepuce.

The *treatment of phymosis*, when not congenital, must be conducted in accordance with its cause; thus, if resulting from inflammation, that must be subdued; if from venereal disease, that must be remedied, when perhaps the contraction and elongation will gradually subside. If, however, the phymosis be congenital, or if it be acquired, but permanent, it must be subjected to operation, and indeed, I think, that all cases of congenital phymosis in children should be operated upon with the view of preserving the health and cleanliness of the parts in after-life.

Fig. 398.



Operations for phymosis may be conducted on two plans; the elongated and contracted prepuce may be slit up, or circumcision may be performed. Slitting up of the prepuce, whether upon its upper or under surface, is always, I think, an objectionable procedure, leaving the prepuce of its abnormal length, and more or less fissured and knotted. In all cases I prefer circumcision, as the simplest and speediest operation, and as leaving the most satisfactory result.

Circumcision may most conveniently be performed in the following way (fig. 398):—The surgeon draws the elongated prepuce slightly forwards, until that portion of it which corresponds to the back of the glans is brought just in front of that structure. He then seizes the projecting prepuce with a pair of narrow-bladed polypus-forceps, which he gives to an assistant, who must hold them tightly. With one sweep of the bistoury he cuts off all that portion of integument which projects beyond the forceps, which are then taken away. It will now be found that he has only removed a circle of skin, but that the mucous membrane lining it, still tightly embraces the glans; this he slits up, by introducing the point of a pair of scissors at the preputial orifice; and then, trimming off the angles of the flaps of mucous membrane and snipping across the frenum, he turns back the mucous membrane, and attaches it to the edge of the cutaneous incision by five points of suture, two on each side and one at the frenum. Before introducing

Fig. 399.

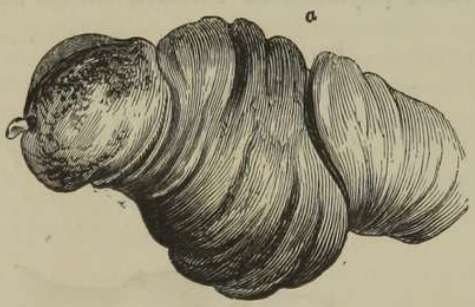
these he will generally find it necessary to ligature a small artery on either side of the penis, and sometimes one in the frenum. Union readily takes place by simple dressing, and a very narrow line of cicatrix is left by which the patient is by no means inconvenienced. In some cases, I have found adhesions between the prepuce and the glans which require to be dissected through, but no inconvenience results from this slight addition to the operation.

If sloughing of the prepuce have occurred, allowing the glans to protrude as in fig. 399, circumcision must be practised.

PARAPHYMOSIS.

In *paraphymosis* the prepuce has been forcibly drawn back behind the glans, which becomes strangled by the pressure exercised by the preputial orifice, so that the parts cannot be replaced in proper relation to one another (fig. 400).

Fig. 400.



This accident principally occurs in boys, or in individuals who have naturally got a tight prepuce, and who on uncovering the glans find it difficult to get this part of the organ back again. This difficulty is speedily and greatly increased by the swelling from congestion that is set up in the constricted glans.

The *treatment* of this condition is sufficiently simple. The surgeon should first try to reduce the swollen organ. He may often succeed in doing this by seizing the body of the penis between the index and middle fingers of either hand, and then endeavoring to draw the prepuce forwards, at the same time that he compresses the glans between the two thumbs and pushes it back (fig. 401).

Fig. 401.

Should reductions not be effected in this way, the constricted and strangulating preputial orifice must be divided. In doing this, the surgeon will observe that the glans is separated from the body of the penis by a deep and narrow sulcus, which is especially evident on the upper part of the organ (fig. 400, *a*). This sulcus, which is overlapped on one side by the glans and on the other by a fold of integument, corresponds to the inner margin of the preputial orifice, and it is by the division of this, in which the stricture is situated, that immediate relief will be given. This operation may readily be done by drawing the glans forwards, then passing the point of a narrow-bladed scalpel into the sulcus on the dorsum of the penis, and making a perpendicular incision about one-third of an inch in length through the integuments at the bottom of the groove directly across it. In consequence of the great stretching of the parts, the incision will immediately gape widely, so that instead of being longitudinal it will appear to be transverse, and then reduction of the glans may readily be effected.

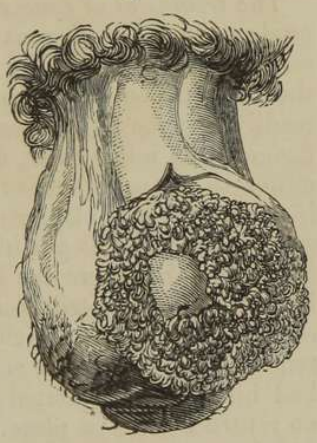
BALANITIS.

Inflammation of the prepuce commonly occurs as the result of local irritation, not unfrequently set up by a gonorrhea. When confined to the prepuce, and constituting *balanitis*, that structure is much swollen, infiltrated, and reddened, and while the inflammation lasts, continues in a state of phymosis. When the mucous membrane of the glans is affected as well, constituting *posthitis*, there is a good deal of irritation and smarting, together with muco-purulent discharge.

The disease requires to be treated on ordinary antiphlogistic principles; the continued application of lead lotion, with the internal administration of salines, will generally remove it; but in many instances the most effectual plan will be found to consist in rapidly sweeping the inflamed surfaces with a stick of nitrate of silver passed down between them on one side of the frenum, and carried round to the opposite side.

Herpes of the glans and prepuce is characterized by the formation of small vesicles or excoriated points upon the mucous membrane of this region, attended by much smarting and itching, and chiefly occurring in persons of a gouty habit of body, with an irritable mucous membrane. This slight affection is often very rebellious to treatment. In many instances, local means alone will not suffice; for though relief may be obtained by powdering the part with the oxide of zinc, by using slightly astringent and cooling lotions, yet no permanent benefit will be derived unless constitutional irritation be removed by treatment of a cooling or alterative character, modified according to the circumstances of the case.

Fig. 402.



Hypertrophy of the prepuce not unfrequently occurs as the result of chronic irritation or disease; it is usually of limited extent, and requires no special interference on the part of the surgeon; but in some instances it may become so extensive as to demand operative interference. Thus Vidal has related and figured a case that had attained such an enormous size, that the organ reached to below the knees, and was as large as a thigh. This monstrous growth was successfully excised.

Warts on the penis have already been described. They may attain a very large size, as in fig. 402, and are best treated by excision.

CANCER OF THE PENIS.

The penis is liable to cancerous disease, which commonly assumes the schirrhous form, and usually springs from the sulcus behind the glans, and may thence invade the neighboring portion of the organ or the prepuce. It may assume the primary form either of a tubercle, of infiltrated cancer of the glans, or of a cancroid ulcer. It has been supposed, and with some show of reason, that congenital phymosis predisposes to the affection, probably by confining the secretions, and thus keeping up irritation of the part. Hey found that of 12 patients with this disease, who came under his observation, 9 had congenital phymosis; and Travers states that the Jews who are circumcised are seldom subject to this affection. But as they are a limited community in this country, and as the disease is rare, we cannot draw any conclusive inference from this observation. The affection, however, can occur in individuals who have not suffered from phymosis; of this we have had several instances at the University College Hospital.

The progress of the disease is usually somewhat slow; the organ enlarging and hardening, without any very great degree of pain. If it form as a tubercle, it may, after a time, give rise to a large irregular and sprouting mass, having a granular fungous appearance, bleeding with much fetid discharge, enveloping and at last implicating the glans, prepuce, &c. In other cases it may commence as a hard scirrhous mass, of a pale reddish-white color, situated on the glans, or between the prepuce and the glans. This increases in size, at last cracks, and allows a serous fetid discharge to exude. Ulceration then rapidly takes place. Sometimes this scirrhus appears to be very distinctly localized; but after its removal it will always present the character of an infiltrated cancer. It is, I believe, always primarily situated at the anterior extremity of the penis, not occurring in the body of the organ, except as a secondary deposit.

Cancer of the penis requires to be diagnosed from warts of a fungoid character. This may usually be done readily enough by comparing the indurated state of the malignant, with the soft and lax condition of the non-malignant affection. From chancrous induration, the history of the case and the way in which it is influenced by treatment, will enable the surgeon to effect a diagnosis. In indurated plastic effusions into the corpus spongiosum, no pain is experienced, and the disease remains in a stationary condition.

The *treatment* of cancer of the penis must be conducted on the principles that guide us in the malignant affections wherever situated, viz.: to remove the diseased organ, provided the affection is localized, the glands not implicated, and the constitution not poisoned. In the case of cancer of the penis, this may readily be done by an operation that is simple in its execution and devoid of danger. In many cases, doubtless, a return may take place, and that speedily, either in the part itself or in the neighboring lymphatic glands; but yet, even if this occur, it is clearly the duty of the surgeon to rid the patient of a loathsome disease, and to put him in a state of comparative comfort for some months; the more so, as there can be no doubt that, in some instances, the disease may be entirely extirpated from the system, evincing no tendency to return. In some of Hey's cases, which continued under his observation, there was no recurrence of the disease for several years; and I have lately seen a gentleman who had his penis amputated for cancer more than twenty years ago, and in whom no return has taken place. The fact is, that we see and hear of those cases in which a recurrence takes place; but those patients who remain free from a return of the infection, do not divulge their infirmity; and it is exceedingly rare in hospital practice to find a patient come back with recurrent cancer in the stump of the penis or the lymphatic glands, which he would certainly do if relapse took place. In those cases in which the operation is not successful, it generally happens that the disease has already implicated the lymphatic glands.

Amputation of the penis must always be performed towards the root of the organ, so as to get well clear of the disease; at the same time care must be taken not to remove it too near the pubes, lest the stump retract under that bone. The operation may readily be done by the surgeon putting the penis upon the stretch, drawing the integument well forward, and then severing the organ at one stroke of the bistoury. It is well not to leave too much skin, lest the flap, falling over the face of the stump, makes the search for any bleeding vessels somewhat difficult, and afterwards may pucker inconveniently. There are usually five arteries requiring ligature; the dorsales penis, one in each corpus cavernosum, and one in the septum. In securing these, trouble is not unfrequently experienced in consequence of the retraction of the stump that is left. The liability to this, however, is lessened by passing a hook through the root of the organ before the operation is commenced, or by directing the assistant to hold it firmly between the fingers, and then to prevent the retraction of the stump, which may otherwise draw back and be buried almost in the perineum. Should it do so and oozing continue, a female catheter must be passed into the

urethra and a firm compress applied with a T bandage. During and after cicatrization, the urethral orifice has a tendency to contract. This may, however, be prevented by drawing forwards the mucous membrane, making four cuts in it with a pair of scissors, and then stitching it to the edge of the cut skin. If the amputation be performed high up, this may be somewhat difficult, and then it may be safer to introduce an elastic catheter before the operation, to perform the amputation upon this, and to leave it in during cicatrization. After the operation, the urine will not be projected forwards, but always passes directly downwards between the legs. Any inconvenience in this respect may best be avoided by adopting Ambrose Pare's advice of adapting a funnel, which may be made of metal or ivory, to the pubes over the stump, and thus carrying the urine clear of the person.

DISEASES OF THE SCROTUM.

Inflammatory œdema of the scrotum is an erysipeloid inflammation of this region, which derives its chief peculiarity from the circumstances of its giving rise to great effusion into, and swelling of the cellular tissue, with a tendency to the rapid formation of slough in it, by which the integument may likewise become affected to such an extent that the testes and cords speedily become denuded. This disease usually originates from some local source of irritation, as fissures, cracks, or urinary extravasation.

The *treatment* consists in elevating the scrotum, fomenting it well, and making early and free incisions into it, more particularly at the posterior and dependent parts, with the view of relieving the tension to which the tissue is subjected by the effusion into its cells; and thus preventing the liability to sloughing. Should this occur, the case must be treated on ordinary principles, when cicatrization will speedily ensue, however extensive the denudation of parts may be; the constitutional management must always be conducted in accordance with those principles laid down in the first division of this work, and with especial attention to the maintenance of the patient's strength.

Hypertrophy of the scrotum seldom occurs in this country, though Mr. Liston once had occasion to remove such a mass weighing 44 lbs.; but in some tropical regions, more particularly India and China, it is of frequent occurrence, and may go on until it attain an enormous bulk, forming a tumor nearly as large as the trunk, and perhaps weighing 60 or 70 lbs. These enormous growths are of a simple character, and constitute the disease termed *elephantiasis of the scrotum*. Tumors of this kind necessarily require extirpation, and in performing such operations there are two points that demand special attention: the first is the preservation of the penis and testes, which will usually be found buried towards the upper part of the mass, and which may be done if the tumor is of small size; and the second is to endeavor to prevent the hemorrhage being of too profuse a character. With this view, the operation ought not only to be performed as rapidly as possible, but the suggestion made by Mr. D. Ferrall of elevating the tumor above the level of the body, for some time before its removal, so as to empty it of its blood, may be advantageously adopted. If the growth be very large, it will be better not to make any attempt at saving the testes or penis, which could only be dissected out by a long and tedious operation, in the course of which there would be danger of the patient dying from hemorrhage.

Cancerous or cancroid disease occasionally affects the scrotum, and as it principally occurs in chimney-sweepers, it has been appropriately enough termed *chimney-sweepers' cancer*. This affection appears to arise from the irritation of the soot lodging in the folds of the scrotum, and is a very common form of cancroid disease. It commonly commences as a tubercle or wart, which at last tends to crack or ulcerate, presenting the ordinary characters of cancerous ulceration. After a time the inguinal and pelvic glands will be seen to be

affected, and the patient, if deprived of his covering of soot, will be found to be cachectic looking.

The *treatment* consists in excising widely the diseased portion of the scrotum, provided the inguinal glands be not involved, or the patient's constitution poisoned. The disease has a great tendency to return, and it is seldom that the patient long escapes with life when once he has been affected by it.

CHAPTER LX.

DISEASES OF THE TESTES AND CORD.

MALPOSITION OF THE TESTIS.

THE testis may be situated in the inguinal canal, not having properly descended into the scrotum, and then may become inflamed, as will presently be noticed; or it may become affected in this situation by malignant disease, rendering its extirpation necessary. The testis may be met with in other abnormal situations; thus, some time ago I saw a case in which one of these organs was situated in the perineum close by the anus, and cases have occurred in which they have been met with in the interior of the pelvis. The organ may sometimes be turned hindside forwards, being retroverted, so that the epididymis is placed in front. In a case of this kind that I had an opportunity of examining after death a few years ago, the epididymis and vas deferens were considerably larger than natural. If a hydrocele form in such a case it will be seated behind the testis.

NEURALGIA TESTIS.

A painful or irritable condition of the testicle may occur without any actual disease of the organ; the pain being either seated in the epididymis, which is the part naturally most tender, in the body of the testis, or stretching along the cord to the loins and groins. It is usually paroxysmal, and is accompanied by great tenderness, and commonly by some fulness of the organ, which feels soft and flaccid; but it is difficult to make a proper examination on account of the agony that is induced by touching the part. This disease chiefly occurs in young men of a nervous and excitable temperament, and is frequently associated with great mental disquietude and despondency, often amounting to a suicidal tendency.

The causes are obscure; in many cases the disease appears to be connected with a neuralgic temperament, but in others it is associated with some dyspeptic disorder, or may be dependent upon local irritation; thus external piles, or the pressure of a varicocele, will often give rise to it.

The disease is usually of a very chronic character. In some instances, however, it ceases spontaneously, after having lasted for weeks or months. When dependent upon constitutional causes, the treatment is extremely unsatisfactory. The administration of tonics, such as iron, zinc, or quinine, the local application of sedatives, as of atropine ointment, or the tincture of aconite, may be of service. In other cases, cold bathing or douching will be beneficial, and in all, keeping the part supported with a suspensory bandage will be advantageous. In the event of there being any local irritation, that should be removed; thus l

have known the disease cease after the excision of external piles; and when it is connected with varicocele, proper measures must be adopted for the relief of that affection. In extreme cases, Sir A. Cooper recommends castration; but such a proceeding is altogether unjustifiable in a disease that is either constitutional or dependent on local causes readily removable.

INFLAMMATION OF THE TESTIS.

Inflammation of the testicle, considering the organ as a whole, may be of two distinct kinds, varying as to seat and as to cause. Thus it may be seated in the body of the organ, constituting *orchitis*, or the epididymis may alone be affected. As to cause, it may be gonorrheal or not.

The seat of the inflammation, at the commencement of the disease, depends greatly upon whether its cause is seated in the urinary passages or not. Irritation in any part of the urethra, whether occasioned by the passage of instruments, the lodgment of calculi, or the existence of gonorrheal inflammation, usually causes the epididymis to be primarily affected, and the body of the organ to be inflamed in a secondary manner. When, on the other hand, the inflammation comes on from injuries, blows, strains, or other causes acting generally, the body of the testis is usually first affected. To all this, however, exceptions will often occur, and orchitis may supervene as the result of gonorrhea, or epididymitis, from a blow; the orchitis in such cases being in all probability a kind of constitutional affection, intimately associated with inflammation of other fibrous tissues, especially with gonorrheal rheumatism; the inflammation of the epididymis, arising from gonorrhea or other irritation of the urinary passages, appearing to result from direct extension of morbid action along the vas deferens.

The *symptoms* necessarily vary to a certain extent, not only according as the disease is of an acute or chronic character, but as it primarily affects the body of the testis or the epididymis. When commencing in the latter structure it is the inferior globus that is commonly first affected, which becomes swollen, hard, and tender. The disease may be confined throughout to this part, but most frequently it invades the whole of the organ, which becomes uniformly enlarged and somewhat ovoid, frequently accompanied by a good deal of effusion into the tunica vaginalis, then constituting the *acute hydrocele* of Velpeau. As the inflammation subsides, the different characters presented by the enlargement of the two constituents of the organ again become apparent. The swelling is therefore due partly to general enlargement of the organ, but in some cases to inflammatory effusion into the tunica vaginalis, which may either be of a purely serous, or partly of a plastic character.

The pain is always very severe, with much tenderness and a sensation of weight, and commonly extends up the cord into the groin and loin. It is generally greatest when the body of the testis is affected, owing probably to the enveloping fibrous tunic preventing the expansion of the organ. Hence it is often spasmodic and paroxysmal, extending up the course of the cord. There is usually a good deal of swelling and redness of the scrotum, with turgescence of the scrotal veins, and a congested state of the cord, with sharp pyrexia, nausea, and perhaps occasional vomiting.

As the disease subsides the body of the testis first resumes its normal character and shape, the epididymis often continuing hardened and enlarged for a considerable period. In fact, the induration that forms in the epididymis may assume a somewhat permanent character, owing to the effusion of plastic matter into it, leaving a hardened mass, and implicating the whole or a portion of its convolutions.

Subacute orchitis usually comes on with the same symptoms, though in a less marked form than in the acute variety. The swelling, however, is considerable,

though of a softer kind. When the disease is chronic, the testis often becomes permanently enlarged and hardened, assuming an oval shape, being smooth, heavy, and uniformly expanded, with a sensation of weight, dragging and severe pain, and a good deal of tenderness on pressure. This form of orchitis occasionally occurs in old people.

The *treatment of inflamed testicle*, whether local or constitutional, is essentially antiphlogistic. Blood should be abstracted from the part by puncturing the veins of the scrotum, a far better method than applying leeches, the bites of which are apt to become irritated. This little operation may be very effectually done by directing the patient to stand up and to foment the scrotum for a few minutes with a hot sponge, so as to distend the veins; these may then be punctured at various points with a fine lancet, and the parts well fomented afterwards, so as to encourage the flow of blood. In this way six or eight ounces may be taken in the course of a few minutes; when enough has escaped, the further flow may be arrested by laying the patient down and elevating the part.

The patient should be kept in bed with the testis raised on a small pillow between the thighs, poppy fomentations being diligently had recourse to. If there is much effusion into the tunica vaginalis, constituting acute hydrocele, relief may be afforded by puncturing this sac with the point of the lancet.

The *constitutional treatment* during the acute stage consists in the administration of salines and antimony, with henbane in full doses, so as to give an aperient, a diaphoretic, and a sedative together; when this begins to act, great relief is usually afforded.

As the inflammation subsides, the treatment must be changed. When there is merely a swelling and hardness left, with but little pain or tenderness, the testis may advantageously be strapped with adhesive plaster, so as to give good support and to promote absorption of plastic matter. Fricke of Hamburg has strongly recommended strapping in the acute stage, but I cannot say that I have ever seen any advantage derived from it at this period of the disease, though I have many times seen it tried; it has usually appeared to me to increase, and sometimes very considerably, the pain in the part and the general uneasiness.

In *subacute orchitis* much benefit is usually derived by a short course of Dover's powder and calomel, with early strapping of the testis. When the organ has become enlarged and indurated, as the result of chronic inflammation, it may be advantageously strapped, either with simple plaster or with one composed of equal parts of the Emplast. Ammoniaci cum Hydrargyro and soap-plaster; mercury in small doses, more especially the bichloride, being continued for some length of time, until the plastic matter is absorbed and the hardness disappears.

In strapping a testicle, the scrotum should be shaved, and then drawn tightly upwards on the affected side. The surgeon should next pass a long strip of plaster, about an inch broad, above the enlarged testicle and round the corresponding side of the scrotum, so as to isolate it, as it were. Another strip is now passed from behind, in a longitudinal direction, over the lower end of the testis, and upwards upon the anterior part of the scrotum; and thus, by a succession of horizontal and vertical strips, neatly overlapping and drawn tightly, the organ is completely enveloped and compressed.

Abscess, as the result of inflammation of the testis, is of rare occurrence: sometimes, however, the scrotum inflames at one point, where fluctuation becomes apparent, with thinned skin and evident signs of suppuration; a puncture should here be made, and the pus let out as soon as formed. Sometimes abscess may occur in another way; inflammation is set up in the tunica albuginea, adhesion takes place between the testis and the scrotum, abscess forms under the fibrous coat, and this giving way, the pus gets vent externally through the

integuments. Into the aperture that necessarily results, a portion of the secreting tissue of the gland sometimes projects, and, becoming inflamed, forms a red, granular, and fungous mass, protruding through and overlapping the edges of the aperture. The treatment of this condition will be considered when we come to speak of the scrofulous testicle.

Inflammation of the testis *in the inguinal canal* may sometimes take place, even in adults, when the organ has not descended through the external ring, giving rise to a train of symptoms of a somewhat puzzling character, and that closely resemble those of strangulated incomplete hernia, with which, however, it must be borne in mind that it may be associated (p. 799). On examination, in these cases, a large, irregular tumor, in some parts hard, in others soft, very tender to the touch, and occasioning a sickening sensation when pressed, will be found in one of the groins, in the situation of the inguinal canal. There is usually a tendency to vomiting, and some constipation, with coliky pains in the abdomen. These symptoms, however, are generally not very persistent, and the constipation readily yields to the administration of purgatives. On examining the scrotum, it will be found that the testis on the affected side is absent, and, on passing the finger into the external ring, the organ can be felt to be lodged in the canal. In consequence of the proximity of the peritoneum to the inflamed testis, this membrane occasionally becomes involved in the morbid action, and, as the result of the constriction of the tendinous and aponeurotic tissues in this situation, sloughing has occasionally occurred. Either of these conditions may lead to a fatal termination.

The treatment should be actively antiphlogistic. Leeches must be freely applied over the part, and blood should be taken from the arm if the patient is young and strong; salines with antimony being at the same time administered, and fomentations diligently persevered in.

In some cases the inflammation of the testis may extend, or the disease may from the first be limited to the cellular tissue of the cord, giving rise to tumefaction, with a good deal of pain and tenderness along it, and eventually the formation of abscess, accompanied by the usual signs of suppuration. The treatment of such a case must be conducted on ordinary principles — early discharge for the pus being secured.

HYDROCELE.

By hydrocele is meant an accumulation of serous fluid, formed in connection with the testis or cord. Most frequently the fluid occupies the sac of the tunica vaginalis, constituting a true dropsy of it; in other instances, it appears to be formed in distinct cysts, situated either in connection with the testis, or upon the cord. Hence, hydroceles are commonly divided into those that affect the tunica vaginalis, and the encysted variety.

Hydrocele of the tunica vaginalis may occur as the result of acute orchitis, the inflammation of the testis causing the effusion of a quantity of limpid fluid into its serous investment. This, however, is not the kind of hydrocele that is commonly met with; the fluid so poured out as the result of active inflammation, usually becoming absorbed as the parts recover their normal condition. The ordinary hydrocele occurs as a chronic disease, without any signs of inflammation of the testicle, or, at most, slight tenderness of that organ. It is most frequently met with in individuals about the middle period of life, and generally in persons of feeble power, or in those of a cachetic or gouty constitution, commonly without any evident exciting cause.

In young infants, hydrocele is not unfrequently seen, and in them it may affect two forms: either the ordinary one, similar to what occurs in adults, in whom the tunica vaginalis constitutes a closed sac filled with fluid; or a less common variety, in which the accumulation of fluid in the tunica vaginalis

communicates, by the persistence of a cavity or canal in the funicular prolongation of the peritoneum investing the cord, with the general cavity of that membrane. This form of hydrocele is *congenital*, and the fluid in it occupies the same position that intestine does in a congenital hernia. It may readily be recognized by the fluid being made to flow back into the general peritoneal cavity, by raising or squeezing the tumor. But although this may be considered to be the true congenital form of hydrocele in infants, the other variety of the disease also occurs in them when but a few days old, and very possibly even at the time of birth.

The *symptoms* of hydrocele are tolerably evident. The disease begins with a degree of swelling and weight about the testis, which may at first be soft, but after a while becomes hard and tense, or it may be so from the very commencement. Whatever its original condition, the tumor soon becomes oval or pyriform in shape, being narrowed above, rounded and broad below; it is smooth and uniformly tense and hard, often having a semi-elastic feel. It reaches upwards along the cord, towards the external abdominal ring, which, however, is never invaded by it, and the cord is usually distinctly to be felt above the upper margin of the tumor. Most commonly the size varies from that of a hen's egg to a small cocoa-nut, but sometimes it may attain a considerably greater magnitude than this, and will then cause much deformity of the parts, as it reaches up close to the external ring, and drags over the penis, causing that organ to be buried in it.

The most characteristic sign of hydrocele is its translucency by transmitted light. This may always be detected, by the surgeon grasping the posterior part of the tumor with one hand, so as to put the integuments on the fore part on the stretch, then placing the edge of the other hand along the most prominent part of the swelling, and having a lighted candle held close behind. On making this examination, the tumor will appear transparent; if, however, the walls of the sac be thick, or the fluid dark, the transmission of light through it may not be perceived unless the examination be conducted in a darkened room. We have already seen that the ordinary hydrocele of the tunica vaginalis may vary as to size; it may also differ as to shape; in some cases being globular, in others constricted in the middle, or of an hour-glass shape.

The quantity of liquid varies considerably; there is usually from six to twelve or twenty ounces, but I have known a hydrocele contain more than one hundred and twenty ounces. The fluid is generally clear and limpid, and of a straw color; but in very large and old hydroceles it may become of a dark-brownish or chocolate hue, owing to the admixture of disintegrated blood; and will then be found to contain flakes of cholesterine. The sac is usually thin, but in some old cases becomes thick and dense, lined by a kind of false membrane, and divided by septa or bands, occasionally to such an extent as almost to separate it into distinct compartments. When the sac is thick, and the fluid opaque and turbid, there may be considerable difficulty in detecting the translucency.

The testis is generally somewhat enlarged, especially about the epididymis, and frequently slightly tender, more particularly in the early stages of the complaint. It is almost invariably situated at the posterior part of the sac (fig. 403), but may sometimes be found towards its anterior part. When this is the case, the epididymis will be found turned towards the front, owing to the organ being retroverted.

The coverings of a hydrocele are the same as those of testis. Besides the integumental structures, aponeurotic prolongations from the intercolumnar and cremasteric fasciæ may be traced over the surface of the swelling (fig. 404).

The *treatment of hydrocele* is divided into the *palliative* and *curative*. By the *palliative* treatment the surgeon simply seeks to relieve the patient of the annoyance induced by the bulk or weight of the tumor; but the *curative* has for its object the permanent removal of the disease.

The *palliative* treatment consists in the use of a suspensory bandage and cooling lotion, or of tapping with a fine trochar. These simple means, how-

Fig. 403.

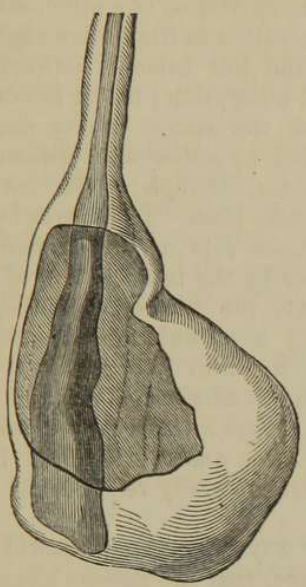
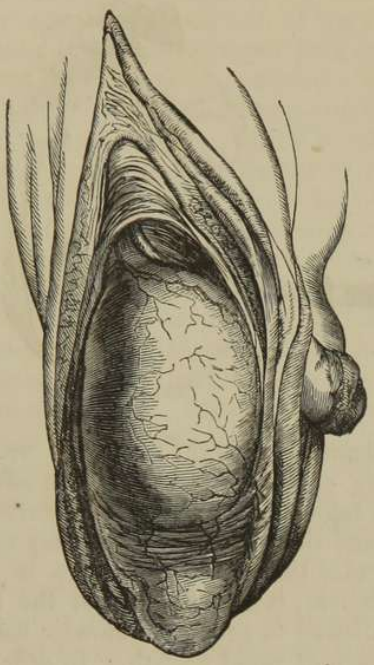


Fig. 404.

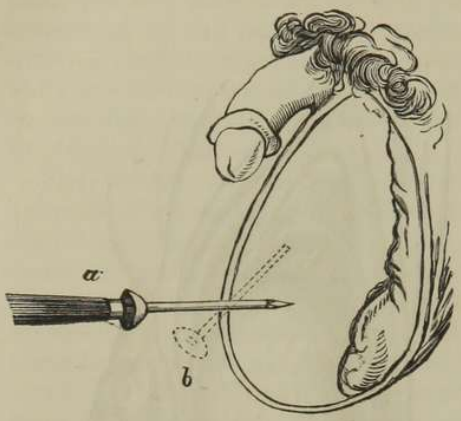


ever, will sometimes succeed in effecting a radical cure. Thus, in infants it will happen that the application of evaporating and discutient lotions may remove the effused fluid; and indeed it is seldom that any other plan of treatment than this is required in young children. The best lotion for the purpose consists of one composed of ʒj of muriate of ammonia, ℥j of spirits of wine, to ℥viij of water; with this the scrotum should be kept constantly wetted, and if there be a communication with the peritoneum, a truss should be kept applied over the external ring. In adults it occasionally happens that simple tapping of the tumor has affected a radical cure. Some years ago a gentleman from Cuba consulted me for a small hydrocele which had been forming for several months; I tapped it with a fine trochar, and drew off about five ounces of fluid. This was followed by a radical cure. This case bears out a remark made by Sir B. Brodie, that the few instances in which he had known simple tapping produce a radical cure occurred in West Indians. This simple operation is not altogether, however, destitute of danger; I have known an old man die from inflammatory œdema of the scrotum after being tapped. After tapping it usually happens that the hydrocele slowly forms again, attaining its former bulk at the end of about three months.

In tapping a hydrocele a few precautions are necessary, the principal being to avoid injuring the testis, or puncturing one of the scrotal veins. In the majority of cases the testis is situated at the back of the tumor, and is consequently altogether out of the way of the trochar, if this is introduced as it should be, by the surgeon putting the anterior part of the hydrocele on the stretch by grasping it behind with his left hand, and then pushing the trochar into the lower part of its middle third in front, carrying the instrument at first directly backwards (fig. 405 *a*), but as soon as it has perforated the sac, directing its point upwards (fig. 405 *b*). If the testicle has been found, on examination with a lighted candle, to be on the forepart of the tumor, where it may sometimes be felt as well as seen, the hydrocele should be tapped at the side or

behind. Before using the trochar, it is well to see that the canula fits closely round the neck of the stylet, and above all that the instrument is not rusty by having been carelessly put aside after use on a previous occasion.

Fig. 405.



The *curative* treatment has for its object the excitation of a sufficient degree of inflammation in the tunica vaginalis to restore the lost balance between secretion and absorption; but it is not necessary that the serous cavity should be obliterated by adhesions between its opposite sides, though these not unfrequently take place. The means by which the surgeon sets up this inflammation are either by the introduction of a small seton into the tunica vaginalis, or by throwing a stimulating injection into that cavity after tapping it. Whichever plan is adopted, a certain amount of inflammation ought to be set up. This is always attended by considerable swelling of the testis, and by the effusion of a fresh quantity of fluid into the tunica vaginalis. As this is absorbed, the part gradually resumes its normal bulk, and the disease will probably not return.

In order that the radical cure, in whichever way undertaken, should be safe and efficient, it is necessary, in the first instance, that the disease should have been allowed to get into a chronic condition, more particularly if the hydrocele have been of rapid growth. In order to prevent its attaining too large a size, it will be well to adopt palliative tapping once or twice before attempting the radical cure. Care must also be taken to remove all inflammation and tenderness about the testis, before having recourse to this means of treatment. If attention be not paid to this, recurrence of the hydrocele will probably ensue. After the proper amount of inflammation has been set up, it will be well to treat the patient as if he were suffering under an ordinary attack of orchitis, confining him to bed or to the couch for a few days; indeed, I look upon care in the after-treatment as of very considerable importance in securing a favorable result to the case.

The cure by the introduction of a seton, though formerly much employed, is seldom practised at the present day, chiefly on account of the danger of exciting too much inflammation. It may, however, conveniently be had recourse to in the true hydroceles of children, and in some of those cases in which the injection fails, if practised in the manner that will immediately be described.

The *treatment by injection* is the one that is commonly employed; it consists in tapping the tumor in the usual way, and then throwing a sufficient quantity of stimulating fluid into the tunica vaginalis through the canula, so as to excite a proper amount of inflammation in it. The liquids that are employed are generally either port-wine or a solution of the sulphate of zinc of the strength of ʒi to ʒxii, or most commonly the tincture of iodine. If the port-wine or solution of the sulphate of zinc are employed, a sufficient quantity partly to distend the sac should be injected from an india-rubber bottle or brass syringe that can be adapted to the canula; six or eight ounces are commonly required for this purpose, and it should be allowed to remain in for some minutes before being evacuated.

The tincture of iodine, originally introduced by Mr. Martin whilst practising at Calcutta, is now commonly preferred as a more certain and a safer mode of treatment than any other. It is usually sufficient to inject about ʒi or ʒii of the pure tincture. It should be left in for a few minutes, in proportion to the

amount of pain it occasions, and then allowed to escape. A good deal of inflammation will usually be set up, on the subsidence of which, the cure will be found to have been effected.

Useful as the iodine injection is, it sometimes fails in producing a radical cure of hydrocele; this is attributable to two causes: the first is, that in some cases sufficient inflammation is not set up to induce that condition of the tunica vaginalis which is necessary for a radical cure. It is well known that when a hydrocele is radically cured by injection, it is so, not by any adhesion taking place between the two opposite surfaces of the tunica vaginalis and a consequent obliteration of its cavity, but by the inflammation that is artificially induced, exciting such a modification of this membrane as to restore the balance between the secretion and absorption of the fluid, by which it is naturally lubricated. Now in some cases sufficient inflammation is not induced by the introduction of the irritating fluid, to restore the natural balance between these two functions of the membrane; and the tunica vaginalis gradually fills again after the injection, as it would after the simple operation of tapping. It occasionally happens that the patient may suffer excruciating agony at the time of the injection, from the contact of the stimulating fluid with the surface of the testis, and yet little or no inflammation be excited. The amount of suffering, therefore, at the time of the operation, is by no means proportionate to the amount of consecutive inflammation likely to be set up. Indeed the reverse would appear to be the case in many instances; and I have often observed that in those cases which progress most steadily to a radical cure, there is but a moderate amount of pain experienced at the time of the injection.

There is a second way in which injections would appear to fail; a considerable amount of inflammation is excited, effusion takes place into the tunica vaginalis, which, in the course of three or four days becomes distended to the same size, or nearly so, that it had attained previously to the operation; but this effused fluid, instead of being absorbed by the end of the second or third week, remains unchanged in bulk, or absorption goes on to a certain point, and then seems to be arrested; the tunica vaginalis remaining distended with a certain quantity of fluid.

The proportion of cases in which the iodine injection fails to bring about a radical cure of the hydrocele is variously estimated by different surgeons; thus Mr. Martin states that in India the failures scarcely amount to 1 per cent. Velpeau calculates them at 3 per cent. I am not aware that any statistics of this mode of treatment in this country have been collected; but the general opinion of surgeons would appear to be decidedly in its favor as being the most successful, as well as the safest plan of treatment that has yet been introduced. In this opinion I fully coincide: but yet I think it by no means improbable that the success of the iodine injection in this country might not prove to be quite so great as is generally believed. I have, during the last few years, seen a considerable number of cases of simple hydrocele of the tunica vaginalis, both in hospital and private practice, in which a radical cure had not been effected, although the iodine injection had been had recourse to by some of the most careful and skilful surgeons of the day as well as by myself.

There can be no doubt that, as a first remedy, the iodine injection is preferable to the seton, in the treatment of hydrocele; but when the injection has failed, and this from no want of care on the part of the surgeon, or of attention to the after-treatment of the case, but apparently from insufficient inflammatory action having been set up in the tunica vaginalis to restore the lost balance between secretion and absorption in this membrane, the seton will, I think, be found to be the most certain means of accomplishing our object. It is true that several objections may be urged to the use of the seton; it requires much watching and care, and is occasionally apt to excite a dangerous amount of inflammation in the cellular tissue of the scrotum; and these objections are to my

mind sufficiently valid to prevent our employing it as the ordinary treatment for the radical cure of hydrocele. But it must be remembered, that the particular cases to which I am now alluding are those in which ordinary means have proved insufficient to excite proper action, and in which, consequently, it would appear as if a greater amount of irritation could safely be borne. Indeed, nothing is more remarkable than the difference in the intensity of the inflammation that is set up in different individuals by the means that are commonly employed in the treatment of hydrocele. In some cases the most irritating injections may be thrown into the tunica vaginalis, or a seton be drawn through the scrotum and left there for days, not only without giving rise to any injurious inflammation, but without setting up sufficient action to bring about a cure of the disease; whilst in other instances simple tapping may effect a radical cure, or may give rise to such an amount of irritation as to terminate in fatal sloughing of the scrotum.

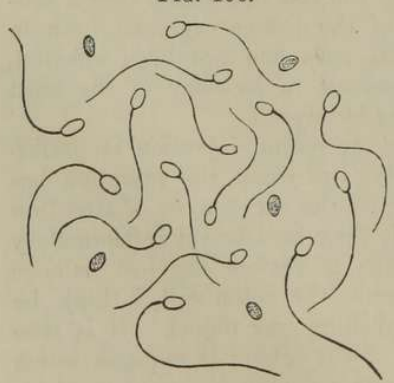
The seton that I employ in these cases is composed of one or two threads of dentists' silk. It may be introduced by means of a nevus needle, the fluid of the hydrocele being allowed to drain away through the punctures thus made; or, far better, by tapping the hydrocele, and then passing a needle, about six inches long armed with the seton, up the canula, to draw it through the upper part of the scrotum, and then removing the canula, and cutting off the needle, to knot the thread loosely (fig. 138). The thread should not be removed until the scrotum swells and becomes red, with some tenderness of the testis and effusion into the tunica vaginalis. When these effects have been produced, it may be cut and withdrawn, and the case treated in the same way as when the radical cure has been attempted by iodine injection, viz., by rest and antiphlogistic treatment. The length of time that is necessary for the seton to be left in before sufficient, or even any inflammatory action is produced varies very considerably. In most instances the proper amount of inflammation is excited in from twenty-four to thirty hours; but in other cases it may be left in for ten or twelve days, giving rise to but little inflammation, although a radical cure may result.

ENCYSTED HYDROCELE.

In this variety of the disease the fluid does not lie in the tunica vaginalis, but is contained in a cyst which projects from the surface of the epididymis or testis, and pushes the serous investment of the gland before it.

These cysts are much more frequently found connected with the epididymis, than with the body of the testicle. Indeed, Mr. Curling has pointed out the fact, that small pedunculated cysts about the size of currants, and composed of a fine serous membrane, lined with tesselated epithelium, are very frequently found beneath the visceral tunica vaginalis covering the epididymis. They are very delicate in structure, contain a clear limpid fluid, and are very liable to rupture. They are met with at all ages after that of puberty. According to M. Gosselin, after the age of forty, they occur in at least two-thirds of the testes examined with this view. Cysts, such as these, may remain stationary, of small size, and not be detected during life, being merely pathological phenomena; they may rupture into the tunica vaginalis; or, they may enlarge and become developed into tumors of considerable magnitude.

Fig. 406.



The fluid of these cysts possesses the remarkable characteristic discovered by

Mr. Liston, of containing spermatozoa (fig. 406); an observation that has been fully confirmed by many subsequent observers. Though spermatozoa do not always exist in this fluid, yet they are usually met with sometimes in small quantities, at others so abundantly as to give a turbid or opalescent appearance. This admixture of spermatozoa, with the clear fluid of the cyst is probably due, as pointed out by Mr. Curling, to the accidental rupture of a seminal duct into an already existing cyst. Spermatozoa have also, but very rarely, been found in the fluid of an ordinary hydrocele of the tunica vaginalis, and then probably their presence was due to the rupture of one of those cysts into the tunica vaginalis. Hence their presence in the fluid of a hydrocele may in most cases be considered as characteristic of the encysted variety of the disease.

The *symptoms* of encysted hydrocele differ in some respects from those presented by the ordinary form of the disease. The tumor of the encysted variety being smaller, more irregular in shape, and not enveloping the testis completely, but being situated behind it, and rather in connection with the epididymis.

The *treatment* consists in injecting the sac with tincture of iodine, or, in incising the tumor and allowing it to granulate from the bottom. The injection by iodine, though successful in some cases, is not so frequently so in this as in the last variety of the disease, but usually deserves a trial; if it fail, the incision of the tumor will always effect a cure.

HYDROCELE OF THE CORD.

This disease is characterized by the presence of a round or oval tumor, situated on the cord, below or within the inguinal canal. It is smooth, elastic, and if of sufficient size may be semi-transparent on examination by transmitted light. It can be pushed up into the abdomen, but receives no impulse on coughing, and does not alter in size by being steadily compressed. It appears to be formed, in some cases, by the funicular portion of the peritoneal investment of the cord being imperfectly closed and consolidated at points; though it is possible that in other instances it arises as a distinct cystic growth. These tumors may occur at all ages, but are chiefly met with in the young, and are not unfrequent amongst children. The obliteration of the cyst is best conducted by passing a seton through, or making an incision into it, and letting it granulate from the bottom.

The *diffused hydrocele of the spermatic cord* consists in the infiltration of it with serous fluid, contained in rather distinct cells, and giving rise to an oval or oblong irregular circumscribed tumor, extending below and into the inguinal canal. The treatment consists in the application of blisters, or of counter-irritant plasters; should the disease prove very troublesome, an incision might be made down to and into the swelling, so as to let out the fluid and allow the cyst to become consolidated.

HEMATOCELE.

By *hematocele* is meant an accumulation of blood in the tunica vaginalis, distending that sac, and compressing the testis. It is of two kinds, *traumatic* and *spontaneous*. The traumatic is the most common form of the disease, usually arising from a blow on, or a squeeze of the testis, by which one of the veins ramifying on the surface of the gland is ruptured and blood poured into the tunica vaginalis. It may also arise in tapping a hydrocele from the point of the trochar being pushed too directly backwards and puncturing the testis. The spontaneous hematocele is a disease of rare occurrence, arising apparently from the rupture of an enlarged spermatic vein into the tunica vaginalis. It attains a larger size, and is altogether a more formidable affection than the traumatic hematocele. In whatever way occurring, a hematocele slowly but gradually increases in size, until it attains about the magnitude of a duck's egg, or even

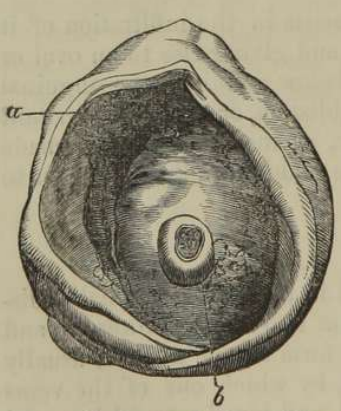
that of a cocoa-nut. It is seldom that it becomes larger than this, but cases are recorded in which these tumors have attained an enormous magnitude. I lately operated in a case in which a spontaneous hematocele had existed for six years; it was as large as a good sized melon, and contained besides about a quart of dark thin blood, a handful of partially decolorized and tough fibrine, the greater portion of which was firmly adherent to the inside of the greatly thickened tunica vaginalis in filamentary and laminated masses, with here and there nodules interspersed. The whole of the interior of the tunica vaginalis closely resembled an aneurismal sac.

The fluid contained in the hematocele, when the disease is recent, consists of pure blood, but when of old standing, is of a dark and grumous character, owing to disintegration of the blood corpuscles. It then usually contains an admixture of cholesterine. The blood so effused will continue fluid for years; but at last it may decompose and set up fatal inflammatory mischief; in some rare instances the tumor becomes partly solidified by the deposit of masses of fibrinous coagulum, lining the interior of the tunica vaginalis, which are sometimes decolorized and arranged, as in the case just referred to, and in one recorded by Mr. Bowman, in a laminated manner, like the contents of an aneurismal sac.

The *symptoms* of a hematocele are generally sufficiently obvious. The occurrence of the tumor subsequently to a blow, strain, or injury when traumatic, its gradual increase in size, somewhat heavy but semi-elastic feel, its pyriform shape, and the absence of transparency, together with the freedom of the cord above, and the want of impulse in it on coughing, will indicate its true character.

The *treatment* of hematocele must vary with the size and duration of the tumor. When small, recent, and having fluid contents, the surgeon may try the effect of tapping it, when it is possible that after the evacuation of the blood, closure and obliteration of the tunica vaginalis will take place. This happened in a case lately under my care, in which, though the disease had existed for three years, a complete cure followed the operation of tapping. Such simple treatment as this, however, cannot be depended upon; and it usually becomes necessary to lay the sac open, and to get it to contract and to granulate from the bottom, when the obliteration of the cavity of the tunica vaginalis necessarily results. If the tumor were of very large size, and the tunica vaginalis much thickened, hardened and parchment-like, with adherent and laminated fibrine, castration might possibly be required. In the instance to which I have already referred, and which has been figured (fig. 407), this was rendered necessary in consequence of these conditions, and was successfully done.

Fig. 407.



Hematocele of the spermatic cord has been observed by Pott, Curling, Bowman and others; it is a rare disease, and usually occurs in the form of a tumor of considerable magnitude, suddenly arising after a strain or some violent exertion. It commences in the inguinal canal, and thence extends downwards along the course of the cord, through the abdominal ring into the scrotum, but it does not surround or implicate the testis, which can be felt free and movable at its lowest part. On incising such a tumor as this, a quantity of blood, partly fluid and partly coagulated, has been found, sometimes contained in a cavity, occasioned by the laceration and separation of the tissues of the cord. The most remarkable case of this kind on record, is one related by Mr. Bowman, in which the tumor, after existing for ten years, had attained so enormous a size, that it reached to

the patella, and was so heavy as to require both hands and a considerable effort to raise it from its bed. In this case, death appears to have resulted from decomposition of the contents of the tumor.

In its early stages, hematocele of the cord would run considerable risk of being confounded with an inguinal hernia. The more diffused character of the swelling, however, its irregular feel and semi-fluctuating sensation, might enable the diagnosis to be made. Hematocele of the cord may always be distinguished from an accumlation of blood in the tunica vaginalis, by the testicle not being implicated in the former case, but surrounded by the fluid in the latter instance.

The *treatment* of this disease must consist in incising the tumor, turning out the contents, and allowing the parts to suppurate and granulate.

VARICOCELE.

Varix or enlargement of the spermatic veins, is a disease that is commonly met with from the age of puberty to about the thirtieth year, seldom commencing later than this. It usually occurs in feeble individuals having the scrotum lax and pendulous, and in some cases appears to have been brought on by venereal excesses. The spermatic veins, extending as they do from opposite the upper lumbar vertebræ to the plexus pampiniformis, which constitutes the base of the pyramidal tumor formed by a fully developed varicocele, are necessarily subject to considerable outward pressure from the weight of so long a column of blood as that contained within them, to which they may eventually yield, becoming much dilated and tortuous. The left spermatic veins are far more frequently affected than the right, partly owing to their compression by feculent accumulations in the sigmoid flexure of the colon, and partly to the obstacle at the mouth, occasioned by their pouring their contents into the left renal vein, at right angles to the current of blood flowing through that vessel into the vena cava. The right spermatic veins are rarely affected, and never, I believe, without those on the left side participating in the disease. In these cases of double varicocele the left is almost invariably the most seriously affected, but I have seen exceptions to this in one or two instances in which the veins on the right side formed the largest tumor.

[A careful study of the anatomy of the parts concerned in varicocele will, we think, clearly show, that the frequent occurrence of this disease upon one side of the body, and its comparative rarity upon the other, is not in reality due to the causes ordinarily assigned. As the result of numerous and careful examinations of the spermatic veins, upon the dead body, we have shown that at the termination of the right spermatic vein in the vena cava, there is always to be found a well marked valve, previously undescribed, formed by the lining membrane of the vein, and sufficient to prevent all regurgitation of blood from the vena cava. No such valve exists upon the left side, at the point where the left spermatic empties into the renal vein.

As has been already observed by Nélaton, the true causes of varicocele are as yet unknown. The greater length of the left spermatic vein is trivial, at most but half an inch; and moreover the vein is protected from the pressure of the colon by a species of fibrous arch thrown across it, at the alleged point of pressure. It must be remembered, also, that the disease most frequently originates between the ages of fifteen and thirty, a period of life during which constipation is not generally met with. With regard to the impeded circulation on the left side, Nélaton remarks, that the obstacle is more fancied than real, since the vein from the testicle curves so as to throw its contents into the renal vein in a direction nearly parallel to the course of the blood in this latter.

We have had repeated opportunities of verifying the facts stated by the French surgeon, and we believe that the immunity of the right side from the disease in question is really due to the presence of the valve, whose existence we have

pointed out; and that the frequency of the affection on the opposite side is mainly attributable to the absence of any such valvular conformation. We would further state that a similar arrangement exists in the ovarian veins of the female; and in the opportunities we have had of examining the diseases of the veins of the right side, we have always found, either that the valve has been absent altogether, or else imperfect in character.—See *American Journal of the Medical Sciences for July*, 1856.]

The *symptoms* of varicocele consist of a tumor of pyramidal shape having a knotted or knobbed feel, owing to the irregularly swollen and convoluted condition of the veins, with its base upon the testis and the apex stretching up to the external ring. The swelling increases when the patient stands up, if he takes a deep inspiration, coughs, or makes any violent exertion. Its size varies from slight fulness of the veins to a large mass, several inches in circumference at the base. When the patient lies down it goes up to a certain extent, but immediately returns to its former magnitude when he stands up again. It is attended by a sensation of weight and sometimes of pain, which is occasionally very acute, of a severe and neuralgic character, even in the scrotum, the groins, and the loins, more particularly when the tumor is unsupported. This pain is greatly increased on the patient walking or riding; so much so, that in some cases he is almost debarred taking necessary exercise, and is prevented following any active occupation. Debility of the generative organs, with a tendency to seminal emissions, frequently accompany varicocele.

The *diagnosis* of varicocele is always sufficiently easy; its peculiar feel, its broad base and narrow apex, the manner in which it goes up when the patient lies down; and returns again when he stands up, are sufficient to distinguish it from all other scrotal tumors. From inguinal hernia the disease may be distinguished by attention to the test described at page 800.

The *treatment of varicocele* must be conducted with reference to the severity of the symptoms occasioned by it, and the extent of the disease. When, as is usually the case, it gives rise to but slight inconvenience, palliative treatment is fully sufficient; but if, as occasionally happens, the disease is a source of very intense suffering, or tends to the induction of atrophy of the testis, or to generative debility, with much mental disquietude or hypochondriasis, then the surgeon may feel disposed to endeavor to cure the varicocele radically.

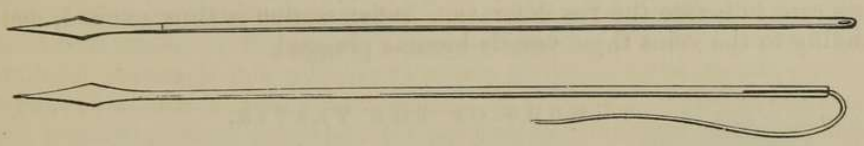
The *palliative treatment* of varicocele resolves itself into means of various kinds, having for their object the support of the testis and the diminution of the length, and of the consequent pressure, of the column of blood. This is usually most conveniently done by supporting the scrotum in a well-made suspensory bandage, or pressure may be made upon the part, as well as support given, by enclosing the testis in an elastic bag. In other cases, support may be afforded by drawing the lower portion of the scrotum on the affected side through a ring made of soft metal, covered with leather. And with the same object, the excision of the lower portion of the scrotum has been recommended, so that by the contraction of the cicatrix, the testis may be pressed up against the ring, and the cord thus shortened. This plan, however, is somewhat severe, and though it might be attended by temporary benefit, the advantage accruing is not likely to be very continuous. The pressure of the pad of a truss on the spermatic cord, as it issues from the external ring, will break the length of the column of blood in its veins, and may thus be of service in some cases, though many patients cannot bear the irksome pressure of the instrument.

In addition to these mechanical means, the part may be braced by cold douching, sea-bathing, and the general strength improved by the administration of iron.

The *radical cure* of varicocele consists in the obliteration of the enlarged veins by compressing and exciting inflammation in them, on the same principle that guides us in the management of varix in other situations. As these

operations cannot be undertaken on the spermatic veins without very considerable risk of inducing an undue, and perhaps dangerous, amount of inflammation in them, and in the loose cellular structures of the scrotum and cord, they should not be had recourse to, unless the disease be a source of very serious inconvenience and pain to the patient. The operation for the obliteration of the spermatic veins may very conveniently be done by using the ordinary hare-lip pins and twisted suture, as figured at page 472. In introducing the pins behind the veins, care must be taken to separate the plexus from the vas deferens. This is best done by letting the patient lie down so as to empty the vessels, when the vas can be distinguished by its firm and corded feel; this must be carefully drawn to one side, and there held between the finger and thumb of an assistant. The surgeon then passes the pins between it and the veins, and including as little skin as possible, applies the twisted sutures in the usual way. Three pins are usually required. A good deal of redness and swelling of the scrotum usually ensue, but after the removal of the pins at the

Fig. 408.



end of eight or ten days, all irritation will subside, and the disease be permanently cured. The patient should afterwards wear a suspensory bandage.

A very ingenious mode of obliterating the veins has been recommended by Vidal, and which, as it does not induce compression of the skin, and only

Fig. 409.

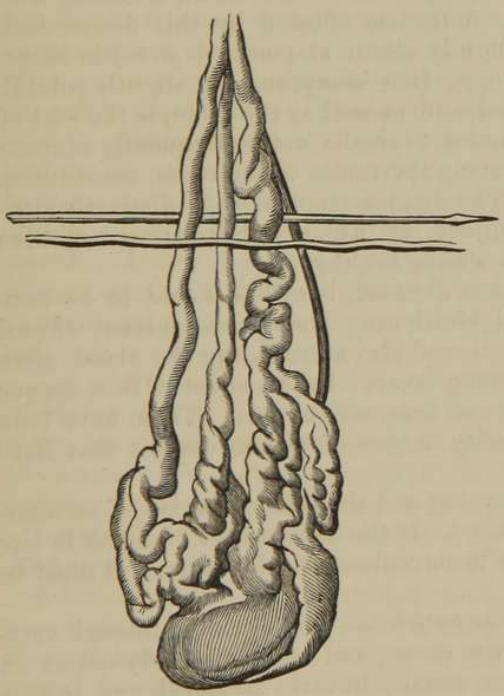
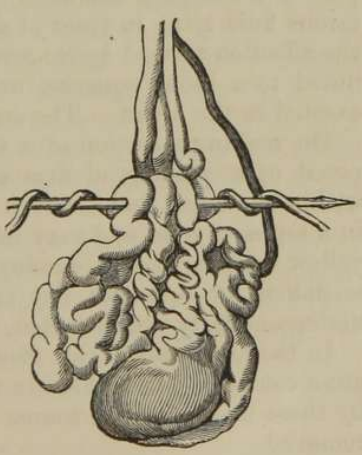


Fig. 410.



requires the introduction of one pin, is attended by less irritation than the former method. It consists in passing a steel or silver pin, having a movable head (fig. 408 *a*) *behind* the veins, between them and the vas deferens, in the

usual way. A fine silver wire is then carried, by means of a needle having a slit to receive it (fig. 408 *b*), *in front* of the veins, but underneath the integuments, being introduced and carried out through the same apertures by which the pin is passed. In this way the plexus of vessels lies between the pin behind and the silver wire in front (fig. 409). The point of the pin having now been removed, compression is made by twisting the ends of the wire round either end of the pin, and is gradually increased by the surgeon every day rolling up the pin so as to twist another turn or two of the wire round it. In this way the veins are not only compressed but rolled up and shortened, and the process is carried on usually for eight or ten days, until they are obliterated by plastic deposit, without being necessarily cut through (fig. 410). Vidal speaks very favorably of this plan, not only as effecting the obliteration of the veins with less risk of inflammation of the scrotum than attends the other method, but as leaving a better result; and I can corroborate his statement, as I have of late employed this practice in several cases with very excellent results. Nélaton has proposed to obliterate the veins of the testis by applying the "Vienna paste" in a grooved pair of forceps across the neck of the scrotum, taking care to isolate the vas deferens. Inflammation is thus excited, and this extending to the veins these vessels become plugged.

TUMORS OF THE TESTIS.

All solid tumors of the testicle are classed together under the generic term of *sarcocele*, and when these are conjoined with fluid accumulations in the tunica vaginalis, are termed *hydro-sarcocele*. Sarcocele is usually divided into the *simple*, the *syphilitic*, the *tuberculous*, the *cystic*, and the *malignant:* which, indeed, comprise so many distinct diseases of the testis, requiring separate study.

1st. *Simple sarcocele* is a chronic enlargement of the testis, resulting from inflammatory mischief in the organ. A testicle affected by this disease feels hard, smooth, solid, though perhaps slightly elastic at points, is ovoid in shape, and usually about as large as a duck's egg. It is heavy, and but slightly painful. The cord is usually somewhat thickened, and, as well as the groin, is the seat of pain of a dragging character. The tunica vaginalis not unfrequently contains serous fluid lying in front of and obscuring the tumor of the testis, constituting the affection termed *hydro-sarcocele*. The disease can usually be distinctly attributed to a blow, squeeze, or other injury, by which inflammation had been excited in the organ. The scrotum is always healthy.

On making a section of a testicle thus diseased, it will be found to be composed of a quantity of firm and hard bluish-grey fibro-plastic matter, effused within the organ and between the tubuli, and also surrounding the gland, often in a series of solid and very firm glistening layers. In the midst of this, opaque yellow spots or masses, cutting smooth and firm, will be seen. These have been mistaken for tubercles, but are in reality masses of plastic deposit that have undergone fatty degeneration.

In the *treatment* of this disease, strapping and the administration of an alterative course of the bichloride may be tried. If the testis do not diminish in size by these means, or is a source of much inconvenience to the patient, it must be removed.

2d. *Tuberculous sarcocele* or *scrofulous testicle.* — This disease, although occasionally met with in individuals otherwise strong and healthy, chiefly occurs in those of a feeble or cachetic constitution, usually in early manhood, and is very commonly associated with a tendency to phthisis. It is essentially characterized by the deposition of tuberculous matter in the testis. These tubercles may be infiltrated or encysted, varying in size from a pin's head to a cherry or plum-stone. When encysted, they are of a bright-yellow color, tolerably firm and

laminated, contrasting strongly with the inflamed gland, in the midst of which they are deposited. Their presence between the tubuli gives rise to inflammation, and eventual disorganization of the structure of the testis with which they become mixed up, so as to form a pultaceous cream or cheesy mass of a dirty buff color.

The *symptoms* of scrofulous testis are well marked. The patient perceives that without any very evident cause, or perhaps as the result of an injury, gonorrheal inflammation, or venereal excesses, the testes gradually and slowly enlarge, often attaining a very considerable bulk, and usually becoming at the same time nodulated and irregular, hard and craggy; the hardness being confined to the nodules, the gland feeling soft between them, and hydrocele occasionally co-existing. The epididymis is most commonly the part that is first affected in this way, though not unusually it is the body of the organ that suffers. Though the disease commences in one testis, both almost invariably eventually suffer, either simultaneously or successively. One of the nodulated masses in the affected testis usually gradually increases in size, the skin covering it becomes red, shining, and thinned, and at last, adhesion forms between it and the testis, indolent suppuration takes place, and on the discharge of the abscess a fistulous opening is left. Through this aperture a fungus speedily protrudes, which grows sometimes slowly, at others rapidly, perhaps attaining a very considerable size (fig. 411). As the fungus increases, the organ atrophies. This fungus is not a new growth, but is a granular mass composed essentially of the tubuli testis and lymph. It is in the form of a pale reddish-yellow granular mass, and is composed of an exuberant outgrowth of the tubuli testis, inflamed and mixed with lymph and tuberculous matter. If the fungus continues small and firm, it may become a very chronic complaint; but, if large, rapidly-growing, and loose-textured, it speedily destroys the testis. It is, however, surprising how long the functions of this organ will continue, though its tissue is in a great measure destroyed, and its structure traversed by suppurating fistulæ. Occasionally, however, strumous disease of the testis developes in a different manner the organ enlarging, generally feeling hard and semi-elastic, but uniform and smooth; in fact, like ordinary sarcocele. In examining such a testis, the strumous matter, mixed with *debris* of tubuli, may be found filling up the tunica vaginalis, into which it has protruded, or with which the true envelopes of the testis are incorporated.

Fig. 411.

The *treatment of strumous testis*, before the fungus has protruded, must be conducted on the general principles laid down when speaking of scrofula: alteratives, tonics, especially the iodide of iron, with cod-liver oil, and general hygienic means calculated to improve the health, must be steadily persevered in for some length of time. The best local treatment will consist in the application of leeches from time to time, followed by discutient iodine lotions, or the iodide of lead ointment.

When the fungus has protruded through one of the fistulous apertures, means must be taken to repress or remove this, lest it go on to complete destruction of the testis. If it be of small size, the better plan will be to sprinkle it with the red oxide of mercury, and to strap it tightly down with a piece of lint and strapping. If larger, it may be shaved off, and the cut surface then dressed with the red oxide of mercury ointment, care being taken, during cicatrization, to repress the granulations below the level of the surrounding integument by strapping and pressure. Mr. Syme has recommended that the pressure should

be effected by the integument of the part; an elliptic incision being made round the fungus, the edges of this depressed down, and then brought over the fungus, and retained there by stitches. This operation I have practised with success.

3d. *Syphilitic sarcocele*, both in its simple and strumous character, has already been considered (page 452), to which I would refer the reader.

4th. *Cystic disease of the testis, or cystic sarcocele*, may be of two kinds, simple and malignant; when simple, it is a disease somewhat analogous to the cystic sarcoma of the breast. The testis becomes much enlarged, indurated, of a yellowish-white and opaque appearance, and studded with a multitude of cysts that vary in size, from a pin's head to a cherry, containing clear, amber-colored, or brownish fluid (fig. 412). This affection, consisting in the alteration and condensation of the orchitic structure, with the formation of these distinct independent cysts, must not be confounded with the accidental occurrence of a cyst or two in a scrofulous testis. It is a local affection, and although the organ may attain a considerable bulk, it never gives any indication of malignancy.

Fig. 412.

This affection has been carefully studied by Sir A. Cooper, who, with great justice, adverts to the difficulty of distinguishing it from other diseases of this organ, more especially from hydrocele. The points to be especially attended to in distinguishing the cystic sarcocele, are its want of translucency, the more globular shape of the organ, its weight, and the enlarged and varicose state of the veins of the cord. If there is any doubt, an exploratory puncture will resolve this, and should always be practised.

According to Mr. Curling cystic disease of the testicle is the result of morbid changes in the ducts of the rete testis, when of an innocent character the cystic disease is characterized by the presence of tesselated epithelium in the cysts, when malignant, by the presence of nucleated cancer cells. In addition to this enchondroma may be met with in both forms of cystic disease, and almost invariably in old cases of the innocent variety.

Cystic sarcocele requires removal of the diseased organ.

Occasionally cystic tumors of the testicle are met with, in which the substance of the organ is atrophied or absorbed, and its place occupied by one or more large thin-walled sacculi containing fluids of different color and consistence, dark or fatty. One of the most remarkable of these anomalous tumors of the testis that I have seen was under the care of my colleague, Mr. Marshall, at the hospital. The diseased organ, which was about the size of an ostrich's egg, and felt partly solid and partly fluid, was found after removal to be composed of a large cyst filled with an oily fluid, like melted butter, which solidified on cooling. After removal, Mr. Marshall found that the sac contained some fœtal debris, and was doubtless of an embryonic character. The patient, who was about thirty years of age, had been affected with the tumor from early infancy.

5th. *Malignant sarcocele, or cancer of the testicle*, not unfrequently occurs, and almost invariably assumes the encephaloid character. It is, indeed, a question whether any other form of cancer ever occurs in the testicle. Dr. Walshe agrees with most observers in doubting the existence of the other varieties of malignant disease in this organ.

Cancer of the testicle most commonly occurs in the first instance in the body of that organ, rarely affecting the epididymis primarily. The ordinary charac-

ters of encephaloid, are always well marked in this affection, which eventually assumes a softened-down, pulpy, and fungous character. Intermixed with the encephaloid are commonly found masses of a bright yellow color, which have sometimes been regarded as tuberculous, but, I believe, erroneously so; for in those instances in which I have had an opportunity of examining them I have found them to consist, as in the simple sarcocele, of plastic matter that was undergoing fatty degeneration. A malignant testicle may rapidly attain a very considerable magnitude, becoming as large as a cocoa-nut in a few weeks or months. When of this size it is, of course, abundantly supplied by blood-vessels; consequently the spermatic artery and accompanying veins will be found a good deal dilated. The lymphatic glands in the neighborhood speedily become enlarged, those in the iliac fossa especially, as may be ascertained by deep pressure in the flank. The inguinal glands do not in general become affected until the skin has become implicated by the progress of the disease. It is then also that the cancerous cachexy rapidly develops itself.

The *symptoms* of encephaloid testicle are usually somewhat obscure in the early stages, although they become clearly and distinctly developed as the disease progresses. The patient first begins to complain of some degree of dragging pain and weight in one of the testes, which on examination will be found to be indurated and enlarged, though preserving its normal shape. The enlargement continues until the testicle attains about the size and shape of a duck's egg, being somewhat tense and elastic, but smooth and heavy. As it increases in size, which it usually does with rapidity, it becomes rounded and somewhat doughy or pulpy in feel in parts, where, indeed, it may almost be semi-fluctuating, though in others it continues hard and knobbed. This alteration in feel is partly due to softening of the substance of the tumor, and partly to its making its way through the tunica albuginea. The scrotum is much distended, reddened, and purplish, and becomes covered by a net-work of tortuous veins; the cord may be felt somewhat enlarged, hard, and knotty. As the disease advances, the scrotum becomes adherent at some of the softened parts, ulceration takes place, and a fungus projects, which presents all the characteristic signs of fungus hæmatodes; it does not commonly happen, however, that the disease is allowed to go so far as this before removal. The pain is not very severe at first, but after a time assumes a lancinating character, extending up the cord and into the loins.

The only treatment of any avail in encephaloid testicle, is the removal of the diseased organ. This operation is not performed so much with the view of curing the patient of his disease, which will probably return in the iliac glands, or in some internal organ, but as a means of temporary relief from the suffering and incumbrance of the enlarged testicle. It is therefore an operation of expediency, and should only be done in those cases in which the disease is limited to the testicle, the cord being free and the lumbar glands not involved; so that if recurrence takes place it may not be a very speedy one.

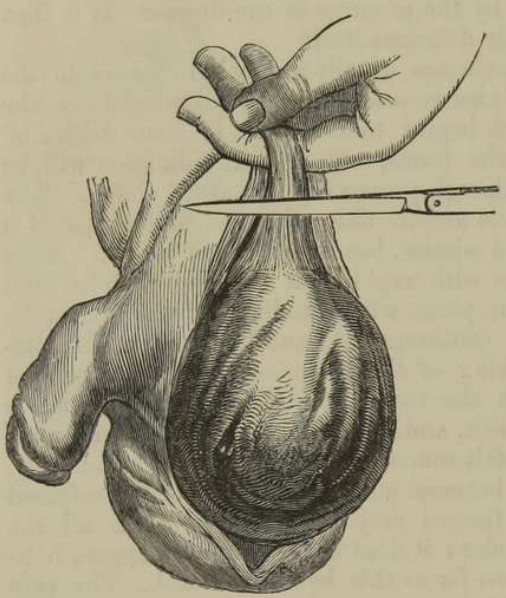
OPERATION OF CASTRATION.

This operation may be required for the various non-malignant affections of the testicle, that have resisted ordinary constitutional and local treatment, and have become sources of great annoyance and discomfort to the patient; in the early forms of malignant disease it may also be advantageously practised. The operation may be performed in the following way. The patient, having had the pubes shaved, should lie upon his back with the legs and thighs hanging over the end of the table. The surgeon should then take his stand in front of the patient between his legs, and grasping the tumor at its posterior part with his left hand, make the scrotum in front of it tense. If the mass to be removed be of small size he makes a longitudinal incision over its anterior sur-

face; if of large size, a double elliptical incision, enclosing a portion of the scrotum. The incision should commence opposite to the external abdominal ring, and be carried rapidly down to the lower part of the scrotum. By a few touches with a broad-bladed scalpel or bistoury, whilst the skin is kept upon the stretch, the tumor is now separated from its scrotal attachments and merely left connected by the cord, which must then be divided. In some cases it will be found advantageous to expose and divide the cord in the first instance before dissecting out the tumor from the scrotum, as in this way a better command over it is obtained.

The division of the cord constitutes the most important part of the operation, whether this be done first or last; as unless care be taken it may be retracted through the abdominal ring into the inguinal canal, where it is extremely difficult to follow it, and where the cut stump may pour out a large and even fatal quantity of blood, infiltrating the cellular tissue, and between the muscles of the part and into the flank. This accident is prevented by giving an assistant charge of the cord before its division, and directing him to hold it tightly between his finger and thumb (fig. 413), or, what is better, by passing a sharp hook through it, and thus fixing it. After the removal of the testicle, two or three arteries in the cord will generally require ligature, as well as a few bleeding branches in the scrotum. Sutures are not required, the edges coming into apposition of themselves; the wound must then be lightly dressed, and allowed to heal by granulation; bagging in the lower part being prevented during the after-treatment.

Fig. 413.

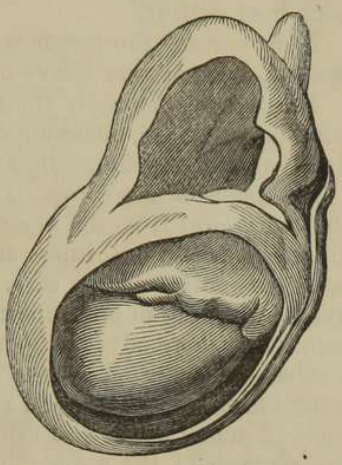


In cancer of the testicle it is of great consequence to divide the cord as high up as possible for obvious reasons. It will not, however, be safe to do this opposite the abdominal ring in the way that has just been described, as there would not be sufficient space for the assistant to hold the cord above the part to be divided. In such cases as these I have found it a good practice to expose the cord by dissection up to the abdominal ring; then to draw it well down and to include the whole in a strong whipcord ligature, tied round it as tightly as possible. The section is then made a quarter of an inch below this, and the operation completed as usual; the cut stump of the cord may retract into the inguinal canal, but cannot bleed if properly tied, and would always be under command by drawing upon the whipcord. This plan of tying the cord, *en masse*, was at one time generally adopted in all cases of castration, but is not now commonly employed. The objection to it is, that by compressing the spermatic nerves with the ligature the after-pain is increased; but this certainly does not always happen, for in three instances in which I have done it at the hospital, but little pain was complained of; and the practice in malignant disease of the testicle has the advantage of enabling the surgeon to divide the cord at a higher point than he otherwise could; which advantage is still further increased by the parts within and below the ligature sloughing away, and thus eventually carrying the section to a level with the point tied.

GENERAL DIAGNOSIS OF SCROTAL TUMORS.

The diagnosis of scrotal tumors is not only of considerable importance, but is often attended with very great difficulty. The more so as they are frequently associated with one another, so that much tact and care are required to discriminate their true nature; thus it is not uncommon to find a hydrocele and a hernia,—a hydrocele and a varicocele,—or, these affections co-existing with a solid tumor of the testicle. In other cases again, as in the annexed figure (414), an encephaloid tumor may co-exist with a hydrocele of the tunica vaginalis, and with an encysted hydrocele of the cord.

Fig. 414.



Tumors of the scrotum may, in a diagnostic point of view, be divided into two distinct classes:—the *reducible* and the *irreducible*. The *reducible tumors* are hernia, congenital hydrocele, diffuse hydrocele of the cord, and varicocele; in all of which the swelling can be made to disappear more or less completely by pressure, and by the patient lying down; reappearing on the removal of the pressure, or on his assuming the erect posture. The mode in which the tumor disappears tends greatly to establish its diagnosis; though the general character of the swelling, and the history of the case, afford important collateral evidence on this point.

In *hernia* there are the ordinary signs of this affection, such as impulse on coughing, &c. On reducing the tumor it will be found that its return into the abdomen is accompanied by a gurgling noise, and by the sudden slip upwards of evidently a solid body. In the other reducible tumors, the diminution and eventual disappearance under pressure are more gradual, and there is no reduction of the mass as a whole.

The gradual squeezing out of the contents of a *congenital hydrocele*, together with its translucency, and the early age at which it occurs, will establish its true character.

In the *diffuse hydrocele* of the cord, there is a uniform semi-fluctuating swelling in and near the ring; in which, however, there is no gurgling, &c., no complete and sudden disappearance as in hernia. It is also less defined, and has a less distinct impulse on coughing.

Varicocele may always be distinguished by its pyramidal shape, and its knotted, soft, and irregular feel. After being reduced when the patient lies down, it will, when he stands up, fill again, even though the surgeon compress the external ring with his fingers. This sign, which distinguishes it from a hernia, occurs also in hydrocele, from which, however, the varicocele may be distinguished by the absence of translucency, the want of fluctuation, and the general feel of the tumor.

Irreducible scrotal tumors are of various kinds, such as omental hernia, hydrocele, hematocele, the various forms of sarcocele, and cancer of the testicle. These tumors, though presenting certain characters in common, yet differ somewhat in the predominance of particular signs; thus the shape of the tumor is usually pyriform in hydrocele, globular in hematocele, and oval in sarcocele, though this is subject to much variation. The weight is least in hydrocele and greatest in sarcocele, proportionately to the size of the tumor. The characters of the surface present considerable differences, being smooth and tense in hydro-

cele and hematocele; often irregular, hard or knotted in the other varieties. The rapidity of the formation of the tumor is greatest in hematocele.

An *irreducible scrotal hernia* may be recognized by its irregular feel, its impulse on coughing, its occupation of the canal, and by the testicle being distinctly perceptible below it.

A *hydrocele of the tunica vaginalis* is always cognizable by its translucency; and the amount of opacity conjoined with this will enable the surgeon to distinguish the degree of enlargement of the testis, and how far there is a sarcocele conjoined with it.

In *hematocele* the tumor is of sudden or speedy formation, somewhat globular, opaque, but not very heavy or hard, and smooth upon the surface.

In *sarcocele* generally the tumor is heavy for its size, frequently globular or irregular in shape, sometimes knobbed, and usually attended by a good deal of dragging pain in the groin, and frequently by some enlargement of the cord.

The point of most importance in the diagnosis of sarcocele is to distinguish the *malignant* from the *non-malignant* varieties. In the malignant, the rapidity of the growth, the softness and the elasticity of the tumor, the implication of one testis only, and the early enlargement of the cord with its indurated and knobbed condition are important signs, especially if the disease occur in young men. In a more advanced condition, the softening of the swelling at parts, with a tuberous condition of the rest, and the occurrence of fungus, with speedy constitutional cachexy, will point to the malignant nature of the tumor. In cases of much doubt and difficulty an exploratory puncture may be made, when the contents of the groove in the needle or the fine canula will probably determine the character of the growth. In more than one instance, in which there was much obscurity attending the diagnosis, I have seen the true nature of the disease cleared up in this way.

CHAPTER LXI.

DISEASES OF THE FEMALE GENITAL ORGANS.

Some of the more important surgical affections of these organs, such as vagino-vesical and recto-vaginal fistulæ, lacerated perineum, and the various forms of syphilitic disease to which they are liable, have already been discussed; the remaining affections, implicating the vagina, the uterus, and the ovaries, are of considerable practical interest, but as their full consideration would lead me far beyond the limits that can be assigned to them in this work, I must content myself with a brief indication of the principal points deserving attention.

INTRODUCTION OF THE SPECULUM VAGINÆ.

Vaginal specula of various shapes and materials are commonly used by surgeons. When the os and cervix of the uterus require exploration, the most convenient instrument is certainly the cylindrical reflecting glass speculum (fig. 415), which, being coated with a layer of tinfoil, covered by India rubber, always presents internally a mirror-like surface, by which a strong body of light is thrown into the bottom of the tube. It has the additional advantage of being very cleanly, and not stained by any caustics that may be used in it. These

specula should be of different sizes, and may be sometimes advantageously bevelled off at the inner end. When the wall of the vagina requires examination, as in some operations of fistula, a bivalve speculum (fig. 416), or a cylindrical one, provided with a sliding side, may advantageously be used. These are generally made of some plated metal, or of pewter.

Fig. 415.

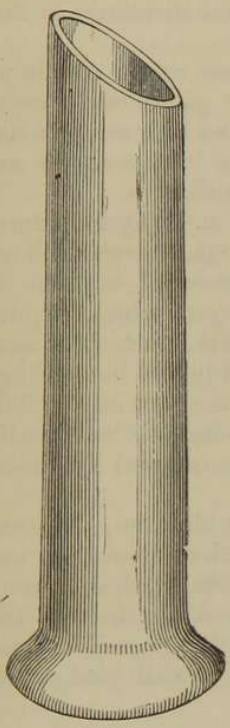
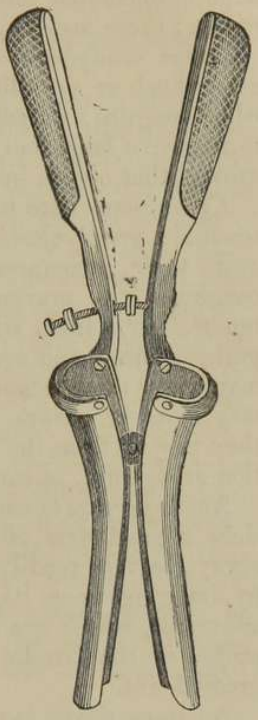


Fig. 416.



The introduction of the speculum may readily be effected without any exposure of the person, under the dress or bed-clothes. There are two positions in which the patient may conveniently be placed for this purpose. In the first, she lies upon her back, with the nates well raised or brought to the edge of the bed or couch, her legs separated, and her feet resting on two chairs; the surgeon standing or sitting in front of the patient, introduces the fore and middle fingers of his left hand into the vagina, dilates its walls, and passes the speculum well greased, gently and steadily between and under them. This position is the most convenient, when caustics require to be applied, but is often objectionable to the patient, as it appears to entail much exposure, though in reality it need not do so. Another mode of introducing the speculum, and that which should always be adopted when practicable, consists in placing the patient on her left side across the bed, with the knees drawn up, and the nates near the edge; the instrument is then introduced in the same way as before, the surgeon sitting by the patient's side. In whichever way the speculum is used, no force should ever be employed; the patient should be placed opposite a good light, and care should be taken that it be introduced fairly to the uterus, the position of which may have been previously ascertained by tactile examination.

INTRODUCTION OF THE FEMALE CATHETER.

The use of the female catheter is often required in various diseases and operative procedures about the genito-urinary organs of women. It should be introduced without exposure by the aid of the touch alone. This may readily be done, as the patient lies in bed, under the clothes. The surgeon standing on her left side, passes his left index finger downwards between the nymphæ until he feels the projection of the meatus urinarius, immediately above the entrance into the vagina; keeping his finger just below this, he uses it as a guide to direct the point of the catheter into the canal.

DISEASES OF THE EXTERNAL ORGANS AND VAGINA.

The vulva and the nymphæ are the seats of numerous morbid conditions, principally consisting of hypertrophy or of verrucous growths from them, or the formation of cysts in their substance.

Hypertrophy of the labia to a limited extent is not unfrequently met with, one labium hanging down considerably below the other. In these cases it will often be found that the enlargement is due to a kind of solid œdema, originally dependent perhaps upon a fissure or ulcer of the part. In other cases again, large fibro-cellular tumors form as outgrowths from the natural structures in this region; these may require removal by simple excision.

Large condylomata or *verrucæ* are often met with here, as the result of gonorrheal or syphilitic disease, forming at last irregular pendulous masses, which require extirpation, either by knife or scissors. I have had occasion also to remove a large nevus by ligature from this situation, and in fact almost any growth that occurs in the fibro-cellular tissue may be met with here.

Cystic tumors are not unfrequently met with in the labia, and may sometimes resemble pretty closely the ordinary forms of inguinal hernia, for which, however, their incompressibility, irreducibility, and the absence of impulse on coughing will prevent their being confounded. These cysts which require removal by a little simple dissection, usually contain a dark, turbid, or sanguineous fluid, and sometimes atheromatous matter. Tolerably free hemorrhage may follow their removal, the excitable tissues of the labia being cut into. This may however always be arrested by pressure and a T bandage. Occasionally they project from the inside of the vagina, and then require removal by dissection or ligature, as can be best practised.

An *imperforate vagina* is occasionally met with in young children, and occasions a good deal of anxiety to the parents. This condition, however, may always be very readily and speedily removed by tearing up the canal as it were, by dragging upon its walls in opposite directions and breaking through the adhesions, which are little more than epithelial, with the thumb nail, a blunt probe, or the handle of a scalpel, and then introducing a small pledget of greased lint.

An *imperforate hymen* has occasionally been met with, causing great inconvenience by the retention of the menstrual secretion, which may accumulate to an immense extent, and become converted into a kind of chocolate-colored grumous fluid; in these cases, incision of the membrane is the only remedy. Occasionally the surgeon's advice may be sought by married women, for a rigid and only partially perforate hymen, when incision with a probe-pointed bistoury, and dilatation with a sponge tent may be required.

Absence of the uterus and ovaries with imperforate vagina is occasionally met with in women, otherwise perfectly well developed. In such cases as these the true condition may be detected by an examination per rectum, and especially by the introduction of a catheter into the bladder whilst the finger is in the rectum, when the point of the instrument will be felt thinly covered through the gut. In a case of this kind in which I was lately consulted, there had been monthly epistaxis. No surgical interference can be of any avail in such cases, and an attempt to restore the vagina might lead to the opening of the peritoneal cavity.

Hypertrophy of the clitoris is occasionally met with; this organ becoming enlarged, elongated, and pendulous, and in some cases attaining an enormous size. When enlarged, it may give rise to a good deal of irritation, and require excision, an operation that would probably be followed by rather troublesome hemorrhage.

Removal of the clitoris, even though not much enlarged, has of late years been recommended as a means of cure in some forms of erotomania. I performed the operation for this purpose on a patient of Dr. Horsbrugh's, and found some difficulty in stopping the bleeding, which at last required the application of the actual cautery before it could be arrested. The operation was I believe followed by marked improvement in the young lady's mental condition.

Tumors of various kinds are met with in the interior of the vagina, springing

from its walls. These may be of a cystic character, but occasionally true mucous polypi are found dependent and projecting from the side of this canal. These may most readily be removed by transfixing their base by a double whip-cord ligature, and then strangling it. In performing this operation, however, when the tumor grows from the posterior wall, care must be taken to ascertain by proper digital examination, that a portion of the rectum has not been dragged down into its base.

Prolapsus of the anterior or the posterior wall of the vagina may occur, giving rise in the first instance to protrusion of the bladder or *cystocele*, in the next, to a *rectocele;* in either case, but especially in the first, occasioning very serious and troublesome consequences, amongst which, chronic irritation of the mucous membrane of the bladder, with perhaps phosphatic deposits in the urine, are the most marked. These protrusions may be supported by the use of properly constructed belts or pessaries. In some cases the surgeon may feel disposed to undertake plastic operations, having for their object the narrowing of the vaginal orifice by freely paring the opposite portions of its walls, bringing together the freshened surfaces by means of the quilled suture, and thus procuring narrowing of the canal and permanent support to the protruded part. The success of such operative proceedings will greatly depend on attention to detail. The mucous membrane at the orifice of the vagina should be dissected off from about half an inch below the meatus on one side, to a corresponding part on the other, in a strip about three-quarters to an inch wide; the dissection being carried well up posteriorly in the fourchette. Two or three deep, and as many superficial sutures should be passed; the deep being left in for about five, the superficial for seven days. Great attention should be paid to cleanliness, the patient lying on her side with a catheter in the bladder communicating with an india-rubber tube to carry off the urine, and the bowels confined by opium.

Various discharges connected with the female organs of generation fall under the observation of the surgeon; these may occur from the external organs, from the mucous membrane covering the cervix uteri, or from the interior of the cavity of that organ. These discharges, when proceeding from the mucous membrane covering the external organs or lining the vagina, are frequently, though not necessarily, of a gonorrheal character; and then require to be treated in the way that has been mentioned at page 876. When of a simple nature, proceeding from mere hypersecretion of these parts, astringent injections, and attention to the general health will usually succeed in effecting a cure.

When these discharges proceed from the cervix or the interior of the os uteri, they will commonly be found to be dependent upon a chronically inflamed or congested condition of the organ, or upon a papillated, granular, fissured, or ulcerated condition of the mucous membrane, often connected with more or less local thickening and induration of subjacent structures. These various conditions, often of a very persistent, insidious, and destructive character, have of late years been fully recognized by the labors of some of the French surgeons, more particularly of Lisfranc, Emery, and Jobert; and in this country their pathology has been greatly elucidated by Simpson and Bennett. To Dr. Bennet especially is due the great credit of having pointed out the true pathology of various uterine diseases that were previously but imperfectly recognized, and of having shown that many of the so-called functional diseases of the uterus are in reality dependent on congestion, inflammation, and other structural lesions of this organ.

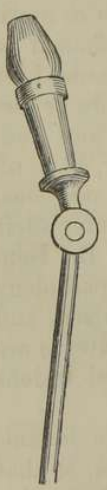
These uterine discharges, occurring usually as the result of chronic inflammation and its consequences—just as we find on other mucous surfaces, as that of the urethra, throat, or eyelids—are attended by various symptoms indicative of local distress, such as pain in the back and thighs, and more especially in the left groin, with dysmenorrhea and usually a good deal of sympathetic con

stitutional irritation, terminating in impaired digestion, malnutrition, and anemia. It is in this condition of the system that many of the so-called hysterical affections are so apt to arise; and the surgeon will often find that the most inveterate case of neuralgia of the joints, the spine, the hip, or the breasts — amaurotic, and other obscure affections connected with nervous irritation — are primarily dependent on chronic uterine disease, and it is only by attacking and removing this that he will remedy the secondary mischief. On examining the condition of the cervix and os uteri in these cases, by means of the speculum, various morbid changes will be observed in them; the cervix is perhaps thickened, indurated, or knobbed on one side, the os is frequently patulous, and the mucous membrane covering these parts will be observed to be erythematous, congested, and perhaps excoriated; not unfrequently in a granular condition, closely resembling what may be observed in some forms of granular conjunctivitis. In other cases, again, true ulceration may exist both upon the cervix and within the os. These ulcers, abrasions, excoriations, or by whatever term they may be designated, are unquestionably a fruitful source of mischief in this situation, giving rise to considerable thickening of subjacent structures, usually to abundant muco-purulent discharge and much sympathetic irritation. Their characters closely resemble corresponding forms of disease met with on the mucous surface in other situations, not attended by loss of substance, but by the development of small pointed granulations or papillæ, from which the discharge is poured forth.

The *treatment* of these various affections of the uterus has been materially simplified since their pathology has been better understood, and practitioners are now generally agreed as to the necessity of the employment of energetic local measures for the removal of these morbid states. To the surgeon who is in the habit of managing local disease on other mucous surfaces, and of removing the structural lesions that result from chronic inflammation in other organs, the treatment of these cases can present little difficulty, as it is conducted on precisely the same principles that guide him in the management of similar affections elsewhere.

The employment of caustics is of essential service in these various forms of chronic uterine disease. In cases of simple ulceration or excoriation, the nitrate of silver in stick applied every third or fourth day will frequently be found to effect a speedy cure. For this purpose, the hinge caustic-holder will be found a useful instrument (fig. 417). If there be much chronic induration conjoined with the affection of the mucous membrane, the potassa cum calce, fused into narrow sticks, may very advantageously be used. In doing this, however, care must of course be taken that the cauterizing action do not extend too far. Hence the surgeon, after lightly touching the diseased part, whether this be on the cervix or inside the os, should immediately inject some weak vinegar and water, so as to neutralize the alkali. After these applications, which should only be repeated at lengthened intervals, the patient must be kept quiet for some time, and any inflammatory symptoms that may be excited, combated in the usual way; it very rarely happens, however, that anything untoward will result.

Fig. 417.



After the removal of the local disease in the way pointed out, any remaining congestion may be got rid of by the application of leeches to the cervix. During the time that these local measures are being adopted, proper constitutional treatment must be had recourse to, with the view of improving the general health on ordinary medical principles, which need not be detailed here, but for a full exposition of which, as well as for a vast deal of important information on the surgical management of uterine affections, I would refer the reader to the last edition of Dr. H. Bennet's work on the Uterus.

The various *displacements* to which the uterus is liable, whether downwards, constituting *prolapsus*, or in the direction of the axis, being twisted, and either *retroverted* or *anteverted*, are causes of much local suffering and constitutional disturbance, and commonly require surgical treatment. These various conditions will frequently be found dependent on inflammatory congestion of the fundus, in consequence of which the organ becomes as it were top-heavy, and is tilted to one side, or descends bodily in the pelvis. The treatment, under such circumstances, must have reference to the removal of the local turgescence by the application of leeches, the employment of astringents, hip-baths, and the recumbent position; occasionally assisted, perhaps, in twist of the organ, by attempts at replacing it by introducing the uterine sound into its cavity, or, when it is prolapsed, by supporting it with appropriate pessaries and the abdominal bandage.

Tumors of the uterus are of various kinds. The most common are those of a fibrous character; these are often of considerable size, and have been found weighing many pounds; they may occupy almost any portion of the uterus, either projecting into the peritoneal cavity, occupying the interior of the organ, or dependent into the vagina. These tumors seldom occur before the age of thirty or forty, and are not very amenable to treatment. In some cases, however, considerable benefit results from attention to position, the occasional application of leeches to the cervix, so as to lessen the congestion of the organ, and the introduction into the vagina every night of a ball composed of equal parts of strong mercurial ointment, wax, and lard, or one containing iodine, or the iodide of lead, with the view of acting as an absorbent on the morbid tissue.

Polypi are not unfrequently met with growing from the inner surface of the uterus, usually from the posterior aspect or fundus. These growths are generally oval or pyriform, smooth, hard, and insensible, and the cause of repeated hemorrhage; and it is a remarkable fact, that in many cases the most violent bleeding proceeds from the smallest tumors. In other cases, the tumors of the uterus are of a soft fibro-cellular, vesicular, or mucous character, attended, like the harder ones, by free hemorrhage.

The *treatment* of polypi of the uterus is best conducted by ligaturing their pedicle. This may usually be readily enough effected by means of a whip-cord ligature applied by Gooch's double canula, which has been variously modified and a good deal improved by different surgeons. The ligature should be gradually tightened, and usually cuts its way through in from three to five days; the tumor swelling, decomposing often with a good deal of fetid discharge, which requires to be carefully syringed away by means of dilute chlorinated lotions. It is a useful precaution not to apply the ligature too near the uterine end of the pedicle, as cases have occurred in which, by so doing, the surgeon has given rise to serious and even fatal inflammation of the womb. Any portion of pedicle that is left will gradually undergo absorption.

The *cauliflower excrescence* from the uterus attended by copious discharge, is a rare and dangerous affection. The only treatment that appears to be of any avail, is to draw down the neck of the uterus by means of a vulsellum, and then to excise the tumor with the surface from which it grows. This operation is not attended by any very serious hemorrhage, and succeeds in ridding the patient effectually of her disease.

Malignant affections of the uterus usually commence in the form of scirrhous tubercle or ulceration of the cervix, attended by the ordinary local and constitutional symptoms of this affection; there is much offensive discharge, and cancerous cachexy speedily sets in.

The *treatment* of these cases must be of a purely palliative character; the administration of opiates and the use of chlorinated lotions must be principally relied on. Excision of the diseased cervix has been recommended, and was

formerly a good deal practised; but this is a barbarous procedure, and one contrary to every principle of good surgery, as it is impossible to rid the patient of scirrhous disease by the partial removal of the affected organ, and its complete extirpation cannot be thought of. Tumors, however, of a simple character requiring removal are occasionally met with springing from the cervix; they must be excised by putting the patient in the position for lithotomy, drawing the uterus well down with forceps and removing them with the knife; this has been done during pregnancy, and even during parturition, with good effects.

OVARIAN TUMORS AND DROPSY.

Ovarian tumors of a cystic character are commonly met with. The cysts may be uni- or multi-locular, and vary greatly in the nature of their contents. These may be either solid or fluid,—often a combination of the two. If fluid, the liquid is usually more or less viscid, albuminous, dark, and variously colored. Ovarian tumor invariably tends to progress to a fatal termination; in some cases, rapidly, in most, gradually, occupying many years in its course.

The treatment of ovarian tumor may be conducted:—1st, by medical means; 2d, by tapping; 3d, by tapping, conjoined with auxiliary measures; 4th, by injection; 5th, by extirpation.

1st. *Medical means* exercise no influence in curing, and but little, if any, in retarding the progress of ovarian tumors. Specific treatment by means of mercury or iodine, has always appeared to me to hasten the progress of the malady by breaking down the constitutional powers of the patient; and attempts at promoting the absorption of the fluid by purgatives, diuretics, &c., are invariably unsuccessful. An ovarian cyst is a rasitic growth, the tissues of which are not influenced to increased power of absorption by the action of deobstruents on the system generally. The utmost that can be done by medical means in such cases, is, to attend to the general health and to support the tumor by a belt.

2d. *Tapping* in ovarian dropsy, may be done as for ascites, through the linea alba; but not unfrequently the tumor presents more distinctly at some other part of the abdominal wall, and may be emptied through the linea semi-lunaris, or, if multilocular, may require the trochar to be inserted at different points into its separate compartments. The paracentesis of ovarian cysts should, unless the disease be very acute, always be deferred as long as is compatible with the comfort of the patient, as it is not only followed by speedy re-accumulation of the fluid, and often by rapid exhaustion, few patients surviving the first operation more than three or four years; but is attended by certain special dangers, such as the risk of induction of peritonitis, or possibly even the puncture of the bladder, or of a coil of small intestine, which is sometimes adherent to the anterior wall of the ovarian cyst, and may be met with where little expected.

3d. *Tapping, conjoined with other means*, has occasionally succeeded in effecting a cure of the disease. These auxiliary means are of various kinds:—firm pressure; incision of the cyst; excision of a portion of its wall, plugging the aperture in it with a tent; the introduction of a catheter or tube; the establishment of a fistulous opening leading into the interior of the cyst, either through the anterior abdominal wall or through the vagina, have all been adopted in addition to simple tapping; and however much these different procedures may vary in detail, they are all conducted on one principle, viz., that of causing the gradual contraction of the cyst and the cohesion of its walls, a principle of treatment which is only applicable to unilocular cysts, and

hence can only be had recourse to in a small number of, and those the simplest cases of ovarian tumor.

4th. *The injection of tincture of iodine* has, of late, been successfully employed both in this country and on the continent. After the tumor has been tapped, from four to six ounces of the tincture should be injected through a catheter passed down the canula and left in. In some cases no constitutional disturbance follows; in others, a severe febrile paroxysm; and in others again, peritonitis has resulted. This method of treatment has been very successful in many cases, and is well deserving a more extended trial than it has as yet received. It is only applicable, however, to non-adherent unilocular cysts.

5th. *Ovariotomy.* Ovarian cysts and tumors may require removal, either on account of their large size and the consequent inconvenience occasioned by it, or from their rapid growth exhausting the patient, and threatening a speedy extinction of life. These operations have of late years been frequently performed with success, and their introduction into surgical practice has been mainly due to the labors of Drs. F. Bird and Clay. Much discrepancy of opinion has existed amongst practitioners as to the propriety of performing these operations, which have been chiefly condemned on the grounds that as the disease for which they were performed, was not necessarily fatal, or at all events not incompatible with long life, it was not proper to subject the patient to a hazardous procedure for its removal; and that the mortality from the operation was so high as not to justify a surgeon in performing it.

With regard to the first objection, it may be stated that ovarian disease is attended by very great discomfort and inconvenience in all cases; and that it is not generally compatible with prolonged existence so soon as it attains such a size as to require tapping. Mr. Stafford Lee states that of 46 patients with ovarian disease, who were tapped, 37 died, and only 9 recovered; and that of the 37 who died, more than one-half did so in four months from the first tapping, and 27 out of the 37 within a twelvemonth, and of these 18 were only tapped once. In those who survive, repeated tappings are required, the interval between each decreasing as they are repeated. The second objection can have little weight with any practical surgeon. The mortality after ovariotomy is not so high as that after many operations, which no surgeon would hesitate for a moment in performing.

Dr. Lyman, of New York, in a valuable essay on this operation, has collected from various sources the particulars of 300 cases; and of these the operation was completed by the removal of the tumor in 208, or about two-thirds of the cases. In one case the result is not stated; but of the 299 cases in which it is, 120 died, or at the rate of 40 per cent.; of the 208 cases in which the operation was completed, 89 died, or nearly 43 per cent. Out of the whole 300 cases, therefore, in 119, or 39½ per cent., was the operation successful in the removal of the disease and the recovery of the patient.

Of the 88 cases in which the operation was abandoned, in 68 instances this arose from adhesions; in 8 cases no tumor was found; and in the remainder the tumor was not ovarian. Of the whole of the cases in which the operation was unfinished, 27 died.

The mortality after ovariotomy is increased by the existence of adhesions. When these complicated the operation, 47 per cent. of the cases died; when they did not exist, 32 per cent. were fatal. The mortality is greater in early life; smaller between the ages of 50 and 60.

When we compare these returns with the rate of mortality after primary amputation of the thigh, amputation at the hip, that following the ligature of the innominate or subclavian arteries, or indeed even in strangulated hernia in hospital practice, we cannot consider it as of a magnitude to interfere with the performance of the operation if other circumstances justify it.

It has further been objected to ovariotomy, that it has not unfrequently happened that after the operation has been commenced, it has been found impossible to complete it, owing to the existence of adhesions between the tumor and the contents of the abdomen. This objection is certainly a grave one; but I believe that with care in examining the tumor, ascertaining its mobility during respiration, the existence or not of crackling under the abdominal wall during the respiratory movements, the absence of connection with the uterus, as determined by finding that organ floating on the introduction of the uterine sound, and the previous non-occurrence of peritonitis, this mistake is not now so likely to happen as formerly, when the liability to it was not suspected.

It is not my intention to enter into the difficult subject of the diagnosis of ovarian tumors. From pregnancy, ascites, tumors of the uterus and omentum, enlargements of the liver, kidney, spleen and stomach, hydatids, hysterical tympanitis, fat in the omentum, stercoraceous accumulations, distension of the bladder, spinal curvature, abdominal and pelvic abscesses, the diagnosis has carefully to be made, and that this is a matter of no slight difficulty is evident from the numerous cases in which errors have happened and are constantly occurring to most experienced practitioners. It is impossible for the surgeon to be too cautious in effecting a diagnosis before he proceeds to open the abdominal cavity in any supposed cases of ovarian disease. There is, however, one form of disease that so closely resembles an ovarian cyst, that I may refer to it; it is a dilated state of the fallopian tube, containing fluid,—in fact, dropsy of that tube. This condition may generally be recognized by the tumor being of moderate size, wholly fluid, having deep pelvic adhesions, displacing the uterus and bladder, and drawing up the vagina into a pouch. The displacement is often very remarkable and considerable. I have seen the bladder flattened out and drawn up as high as the umbilicus—the top of the vagina above the pubes. In these cases the abdominal wall is not so much thinned and expanded as in true ovarian disease. The tumor, which cannot of course be extirpated, is never pediculated.

Operation. — On the day preceding the operation a dose of castor-oil should be administered, and on the morning of it an enema, so that the bowels may be completely emptied. The room having been raised to a temperature of at least 75° or 80° F., chloroform administered, and the bladder emptied by the catheter, the patient must be placed upon a table covered with blankets, in such a way that the legs hang over the end of it, and the abdomen is fairly and evenly exposed. The surgeon, taking his stand between the patient's legs, makes an incision, about four inches in length, from the umbilicus downwards, directly in the mesial line; by a few touches of the knife, the structures, which are usually much thinned, are divided along the linea alba, and the abdominal cavity opened.

There has been much discussion as to the length to which the incision in the abdominal wall should be made, some practitioners recommending that this should be of very limited extent, others that it should reach from the ensiform cartilage to the pubes. No definite rule can be laid down upon this point. The incision must be proportioned in extent to the size and nature of the tumor, and the existence or not of adhesions. If the tumor be cystic, and not adherent, it may be readily enough extracted by making an incision an inch or two in length, in the mid-line, tapping it through this, and then drawing the emptied cyst forwards by means of a vulsellum. If, on the other hand, the ovarian growth be chiefly solid, a larger incision, from four to six inches in extent, will be required. Should adhesions exist, it may even be necessary to go beyond this, though I cannot believe that it is ever necessary to rip up the abdomen

from the sternum to the pubes, for the removal of any tumor, however large or adherent.

If it be found that the adhesions are so extensive and firm that the tumor cannot be removed, it must be tapped, and the wound in the abdominal wall closed.

The tumor now comes into view: if cystic, it must be tapped with a large trochar and the fluid evacuated. Should this be very thick and viscid, the aperture in the sac may be enlarged with a probe-pointed bistoury, and thus its contents let out. In this way the size of the tumor may be so much lessened as to admit of its more ready extraction. If cystic and emptied, it may now perhaps be drawn out through the incision in the abdominal wall without further difficulty. If solid, or if there be any adhesions, the surgeon must introduce his hand, and thus assist in removing the mass, or gently break down any connections it may have formed with adjacent parts. These will chiefly be found at the anterior part, between it and the abdominal wall; seldom or ever posteriorly, or to any of the abdominal viscera, except the uterus. During the withdrawal of the mass from the abdomen, an assistant on either side must press upon the sides of the incision with their hands or with soft napkins, so as to prevent the protrusion of the intestines. This sometimes occasions considerable trouble, especially if the patient have taken chloroform and begin to vomit, when it may be necessary to discontinue the operation for a time.

The separation of the pedicle is the next step, and perhaps the most important one in the operation. This may best be done by drawing the tumor well forwards, transfixing the pedicle with a nevus-needle carrying a strong whip-cord ligature, tying it firmly on either side, and then cutting it across above the constricted portion. In doing all this, a few points require attention. Care should be taken that the needle does not transfix any large artery or vein. This may generally be avoided by spreading out or unravelling, as it were, the pedicle and examining its structure before passing the ligature. After it has been transfixed, and before the cord is tied, it is well to dissect off that portion of the peritoneal investment of the pedicle which corresponds to the line that will be constricted by the ligature. In doing this great care must, however, be taken not to wound the vessels, especially the veins, which are very thin-walled. In this way there will, I think, be less risk of peritonitis, as there is less chance of any slough of the pedicle falling into the peritoneum; and I attribute much of the success that attended the removal of an ovarian tumor, partly solid and partly cystic, weighing about fifteen pounds, which I extracted from a lady, sixty-five years of age, to the adoption of this precaution.

After the ligature of the pedicle, it should be divided about half an inch above the part tied. If it be cut across nearer the ligatures than this, there will be danger of the stump retracting under them, and thus inducing secondary hemorrhage, which has proved fatal in no less than 23 per cent. of the deaths after this operation.

The next point in connection with the pedicle is fixing it properly out of the peritoneal cavity, so that it may not be drawn back into this, as it always has a tendency to do, and thus excite undue inflammation by the presence of the ligatures and resulting slough in the serous membrane. I have found the most convenient way to fix it is to close the lower part of the incision in the abdominal wall by a hare-lip pin passed across it, about half an inch above its angle, and, drawing the stump of the pedicle well out of the abdomen through this, to retain it there by twisting the whip-cord ligature with which it has been tied, in the usual figure of 8 manner, round the pin; in this way it cannot possibly be retracted, and there is no chance of any of the slough or ligature falling into the peritoneal cavity.

The incision in the abdomen must be closed by a series of interrupted sutures passed across from one lip to the other, and the abdominal wall must be still further supported by broad and long slips of plaster, and a laced napkin round the body.

The after-treatment of the case will require the most careful attention. The patient should be kept in bed, in a high and uniform temperature. Nothing but ice- and barley- or Seltzer-water should be allowed for several days, and opium must be given in sufficient and repeated doses, to keep the system slightly influenced by it. The urine must be drawn off thrice in the twenty-four hours, but the bowels should be left unrelieved for at least ten or twelve days, and then merely opened by an enema. As no solid food should be given during the whole of this time, little inconvenience results. If peritonitis comes on, it must be treated in accordance with the rules laid down when speaking of strangulated hernia.

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